

Book of abstracts

**RSC-JAIMA Symposium on Analytical
Chemistry 2026: Computational
Techniques in Analytical Chemistry**

3-4 September 2026 Chiba, Japan



A Message from the Chief Executive Officer of the Royal Society of Chemistry

The Royal Society of Chemistry (RSC) promotes, supports and celebrates chemistry. We work to shape the future of the chemical sciences – for the benefit of science and humanity. This year we are, once again delighted to co-sponsor the RSC-JAIMA Symposium on Analytical Chemistry 2026, together with the Japanese Analytical Instrument Manufacturers' Association (JAIMA).

Analytical chemistry is becoming increasingly interdisciplinary and contributes to many diverse scientific fields and industries. This year's theme, "*Computational Techniques in Analytical Chemistry*", highlights how advances in computational approaches — such as simulations, chemometrics, machine learning and artificial intelligence — have the potential to transform the field.

Now in its sixteenth edition, our symposium continues to bring together leading scientists to further research in this important area. We are also pleased to have the opportunity to recognise talented early career researchers, through the awarding of poster prizes on behalf of ***Analyst***.

I would like to thank all the speakers and participants for their contributions to this symposium and hope that this event presents an opportunity to share knowledge, spark ideas and create new collaborations.

Finally, we are grateful to the JAIMA for their help in organising this event, and we look forward to continuing our close partnership in the future.

I wish you all an informative, productive and enjoyable symposium.

A handwritten signature in dark ink, appearing to read 'Helen Pain'.

Dr Helen Pain, MBE CSci CChem FRSC

Chief Executive Officer, Royal Society of Chemistry

RSC-JAIMA Symposium on Analytical Chemistry 2026 President's Message

We are pleased to host again this year the RSC-JAIMA Symposium on Analytical Chemistry 2026.

The RSC-JAIMA symposium is jointly organized by the Royal Society of Chemistry (RSC), a globally renowned and historically significant chemical society, and JAIMA. It features sessions by distinguished researchers from around the world who present cutting-edge technologies and research findings, along with the poster sessions by students and young researchers involved in analytical chemistry.

This year's theme is "Computational Techniques in Analytical Chemistry." Attention is rapidly increasing in analytical chemistry toward advanced measurement automation technologies and AI-driven data analytics. We hope this symposium will promote technical exchange among researchers and provide a useful opportunity for the audience to obtain new insights.

Lastly, I would like to express my sincere gratitude to all the researchers and committee members contributed to the planning and organization of this symposium.

Masayuki Adachi

President of Japan Analytical Instruments Manufacturers' Association



Message from the Organizers of the RSC-JAIMA Symposium on Analytical Chemistry 2026

We are very honored that the Royal Society of Chemistry (RSC) and the Japan Analytical Instrument Manufacturers' Association (JAIMA) are jointly organizing the RSC-JAIMA Symposium on Analytical Chemistry (RSC-JAIMA) 2026. This year already marks the fifteenth edition of the conference, which until 2023 was known under the name of RSC-Tokyo International Conference (RSC-TIC).

As in previous years, the 2026 event is again held at Makuhari Messe jointly with this year's Japan Analytical & Scientific Instruments show known as JASIS.

The main theme of RSC-JAIMA 2026 is "Computational Techniques in Analytical Chemistry". Plenary and invited talks are given by excellent scientists from both abroad and from Japan, including (in alphabetical order) Prof. Pai-Shan Chen, National Taiwan University (Taiwan), Prof. Peter Gardner, University of Manchester (UK), Prof. Pawin Iamprasertkun, Thammasat University (Thailand), Prof. Masaki Kawano, Institute of Science Tokyo (Japan), Prof. Han Bin Oh, Sogang University (Korea) and Prof. Lingling Shui, South China Normal University (China). In addition, short flash presentations are given by the approximately 100 poster presenters, most of them active young researchers.

Through active discussion, RSC-JAIMA 2026 provides a platform for the exchange of useful information among presenters from academia as well as from industry to promote analytical technologies and analytical instrumentation for future analysis. In order to encourage young talented researchers, poster presentation awards will be given by RSC and JAIMA. We sincerely thank RSC and JAIMA to give us this great opportunity to discuss cutting-edge analytical methods, instrumentation, and other related technologies.

Through the JASIS and the RSC-JAIMA, Asia, Australia, Europe, America, and other regions of the world will form closer relationships to develop analytical technologies and analytical instruments.

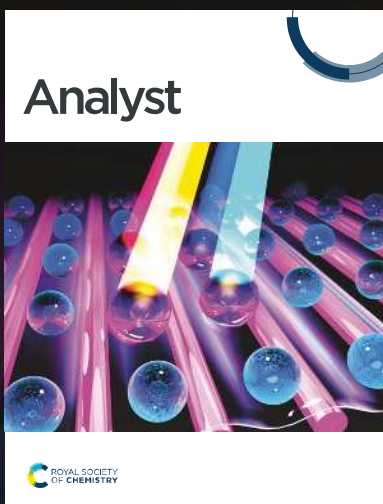
We are looking forward to your participation.

Dr. Hideaki Hisamoto
Organizing Committee Chair
Analyst, Associate Editor
Professor, Osaka Metropolitan University



Dr. Daniel Citterio
Organizing Committee Co-Chair
Fellow of the RSC
Professor, Keio University



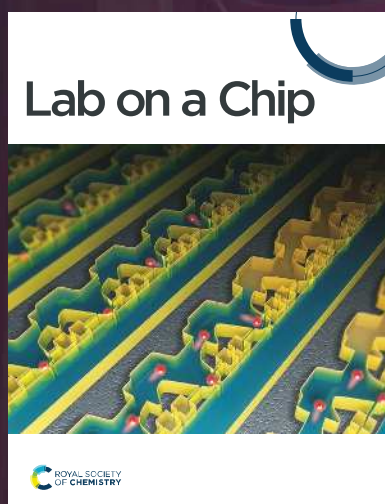


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JASIS



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Peter Gardner
University of Manchester

Droplet Confined Colloidal Assembly and Applications.....
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South China Normal University

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Infrared spectral pathology. Are we closer to clinical adoption?

Dougal Ferguson^{1,2}, Ashwin Sachdeva^{3,4}, Peter Gardner^{1,2}

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University of Manchester, Oxford Road, Manchester, UK, University of
Manchester, Oxford Road, Manchester, UK

³Division of Cancer Sciences, University of Manchester, UK

⁴Department of Surgery, The Christie Hospital NHS Foundation Trust, UK



Biographical Sketch

Peter Gardner is a Professor of Analytical and Biomedical Spectroscopy in the Department of Chemical Engineering and the Photon Science Institute at the University of Manchester. He obtained his BSc in Chemistry from the University of East Anglia in 1984 and his PhD in 1988. This was followed by post-doctoral positions at the Max Planck Institute in Berlin and the University of Cambridge. He is a physical chemist with 40 years of research experience in the field of infrared and Raman spectroscopy. In 1999 he turned his attention to applying infrared microscopy to the analysis of cells and tissue. He has been developing new methods to analyse tissue samples from biopsies with a view to helping pathologists better diagnose cancer. In particular he has been an early adopter of quantum cascade laser (QCL) based imaging which is poised to revolutionise spectral pathology. He is currently president of the international society for clinical spectroscopy CLIRSPEC

Abstract

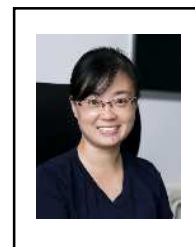
The coupling of focal plane array detectors with infrared microscopes ushered in a new age of infrared hyperspectral imaging and stimulated the field of infrared spectral pathology. Numerous papers have been published demonstrating that the spectra contain key chemical information regarding disease state. Tissue classification using machine learning can be achieved with high degrees of accuracy meaning that the technique is potentially ripe for clinical adoption. Frustratingly, however, despite years of continued effort the field has hardly progressed beyond the proof-of-concept stage. This has been due to a number of factors. Firstly, FTIR imaging instruments are still too slow for a busy pathology lab, taking many hours to image a single piece of tissue. Secondly, the emergency of digital pathology means that tissue classification tasks can often be done based on a standard H&E image with no additional equipment. Thirdly we have been trying to replicate pathology and reduce the subjectivity of the assessment rather than helping clinicians to make treatment decisions. In this presentation I will explain how we have tackled all three of these problems using Quantum Cascade Laser based IR imaging¹, advanced deep learning² and predicting outcome data rather than tissue classification³.

1. Dougal Ferguson, Niels Kroeger-Lui, Domenic Dreisbach, Claire Hart, Diego Sanchez, Pedro Oliveira, Mick Brown, Noel Clarke, Ashwin Sachdeva, and Peter Gardner, “Full fingerprint hyperspectral imaging of prostate cancer cohorts within clinical timeframes using novel quantum cascade laser microscopy”, *Analyst*, 150, 1741-1753, (2025).
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Droplet Confined Colloidal Assembly and Applications

Lingling Shui

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Biographical Sketch

Dr. Lingling SHUI received the B.Sc. and M.Sc. degrees in Chemistry from Shandong University (Jinan, China), and Ph.D. degree in Electrical Engineering from Twente University (Enschede, the Netherlands) in 2009. After a postdoctoral research at MESA+ Institute of Nanotechnology in the Netherlands, she joined the faculty of South China Normal University in 2012. Her research interests lie in the fields of microfluidics and lab-on-a-chip. She has authored or co-authored more than 100 refereed journal papers with over 5000 citations, and has delivered over 50 invited talks/seminars in international/national conferences.

Abstract

Self-assembly has been recommended as a bridge tool bringing basic units to functional structures, and has attracted attentions from multidisciplinary fields. Droplet microfluidics offers a confined fluidic space with pL to nL volume, with controllable physical and chemical parameters for internal particle/molecule manipulation. In this presentation, I will present our recent findings of supraparticles constructed via microfluidic droplet confined particle assembly. The configurable structures of the supraparticles enable its applications in intelligent sensors for pH, ion, molecule and microorganism detection.

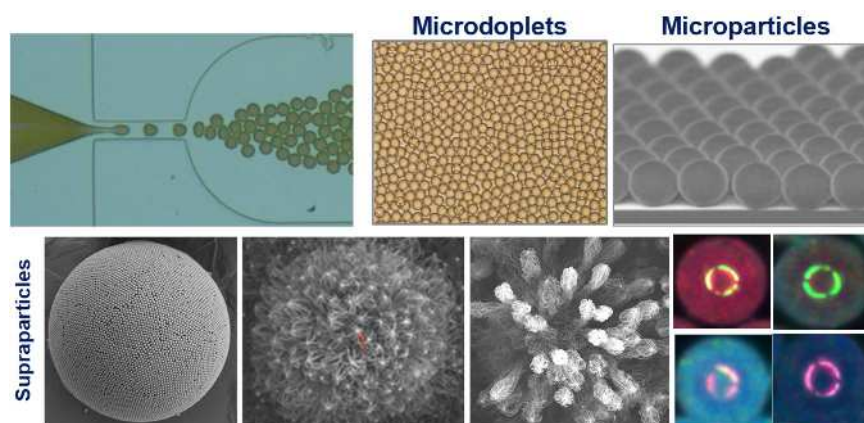


Figure 1. Droplet microfluidics for constructing supraparticles with hierarchical configurations. (a) Droplet generation at the flow focusing area in droplet microfluidic device. (b) Obtained droplets containing colloidal particles. (c) Obtained microparticles via solvent evaporation. (d) Obtained supraparticles with various hierarchical structures^{1,2,3}.

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MOF Crystallography of Microgram-Scale Bioactive Molecules

Masaki KAWANO

Institute of Science Tokyo/TEKMOF Co., Ltd.



Biographical Sketch

Waseda University, Department of Chemistry, Ph.D. (Science, 1993)

Associate Professor (2003-2009), Department of Applied Chemistry, The University of Tokyo. After serving as Professor, Department of Advanced Materials Science, POSTECH (2009-2015), in 2015, he was appointed professor at the Department of Chemistry, Tokyo Institute of Technology, where he currently holds the position.

Since 2024, he has been the founder and CSO of TEKMOF.

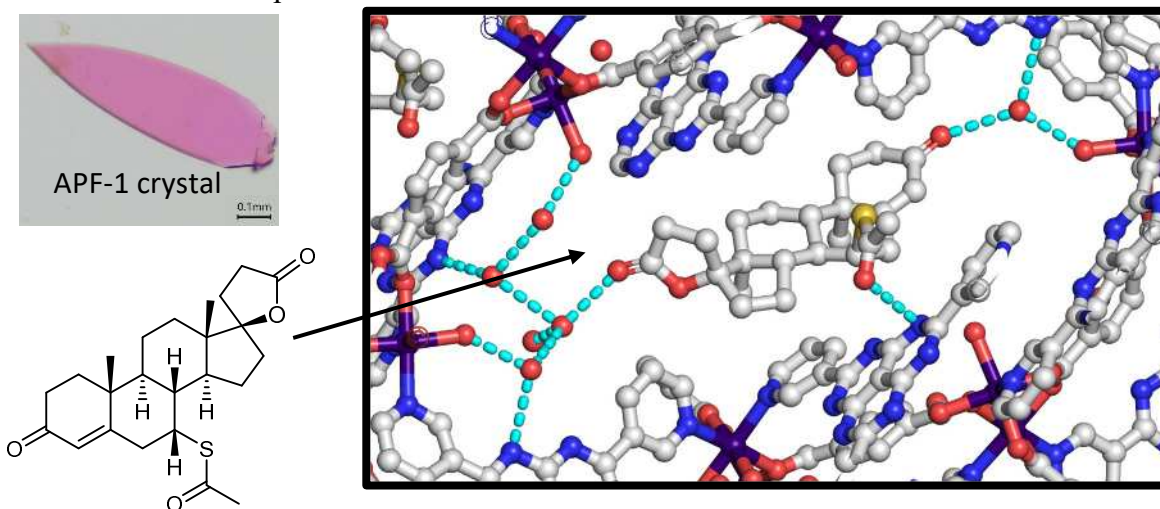
His research interests include Coordination chemistry, Supramolecular chemistry, MOF, In situ chemical crystallography, Crystalline-state photochemistry, ab initio powder X-ray crystallography.

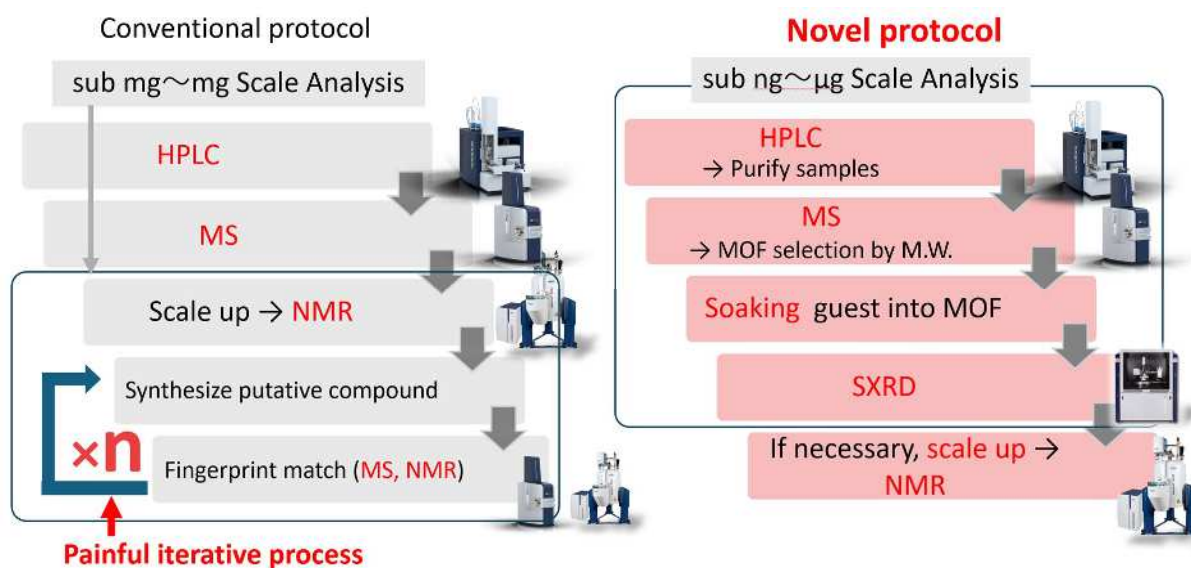
Abstract

We have developed metal–organic frameworks (MOFs) incorporating interactive ligands to trap metastable structures and construct responsive pore environments. An interactive ligand is defined as a bridging ligand bearing functional groups capable of engaging in supramolecular interactions. These ligands enable a range of fascinating functions, including kinetic trapping [1], selective guest recognition [2], ion conductivity [3], non-volatile memory storage [4], and more.

Notably, we have designed adaptable pores capable of visualizing natural products at atomic-level resolution as shown in Figure [5]. While the crystalline sponge method has proven effective for analyzing small molecules [6], it still faces several challenges, such as limitations in molecular size, chemical and physical stability, and issues arising from pseudo-symmetry.

To address these challenges, we are developing new MOF systems tailored for enhanced structural elucidation of natural products. In this presentation, we will share our recent progress, with a particular emphasis on the structural analysis of microgram-scale nucleophilic natural products and medium-sized molecules [7], and the use of a high-speed simulator called Matlantis for structural prediction.





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From data acquisition to knowledge generation: The transformative role of artificial intelligence in analytical chemistry



Pai-Shan CHEN

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Biographical Sketch

Professor Pai-Shan Chen is a Professor at National Taiwan University (NTU), Taiwan, and received her Ph.D. in Analytical, Environmental & Forensic Sciences from King's College London, UK. Her research focuses on mass spectrometry, analytical toxicology, artificial intelligence-assisted analytical chemistry, and the development of innovative LC-MS platforms for forensic, clinical, and environmental applications. Her research spans wastewater-based epidemiology, forensic toxicology, and clinical metabolomics, with recent efforts directed toward applying artificial intelligence to mass spectrometry data for rare disease diagnosis and biomarker discovery. She has been invited to present her work at major international conferences, including TIAFT, AOMSC, and CMSC Asia. Professor Chen served as the Taiwan Representative to the International Association of Forensic Toxicologists (TIAFT) and received the 2024 Young Scholar Award from the Taiwan Society for Mass Spectrometry (TSMS). Her current research explores how artificial intelligence can transform analytical chemistry from a data-generating discipline into a knowledge-generation science, with applications in metabolomics, biomarker discovery, clinical diagnostics, and autonomous analytical systems.

Abstract

Artificial intelligence (AI) is rapidly reshaping analytical chemistry by transforming how complex analytical data are translated into actionable knowledge. While advances in mass spectrometry, chromatography, and sensing technologies have greatly expanded analytical capabilities, the resulting data complexity has shifted the primary bottleneck from data acquisition to data interpretation. AI is driving a paradigm shift across mass spectrometry-based applications. In clinical metabolomics, machine learning models have enabled accurate diagnosis and classification of rare inherited metabolic disorders using urinary organic acid profiles, reducing reliance on expert interpretation. In untargeted metabolomics, AI-assisted platforms facilitate biomarker discovery, automate statistical analyses, improve feature prioritization, and accelerate knowledge extraction from large-scale datasets. Beyond data analysis, AI is increasingly contributing to analytical method development. Advances in generative AI and predictive modeling support data processing, visualization, and reporting, while also assisting in the prediction of feasible analytical strategies, optimization of experimental conditions, and acceleration of method development. By reducing technical barriers and minimizing trial-and-error experimentation, AI may enable analytical scientists to focus more directly on scientific questions and discovery. Recent advances in AI for Science suggest that artificial intelligence may increasingly participate in multiple stages of the scientific process, ranging from data interpretation and experimental design to knowledge discovery and decision support. More importantly, AI has the potential to redefine the role of analytical chemists. Historically, analytical laboratories have focused primarily on data generation, whereas transforming analytical data into scientific knowledge often required fragmented and labor-intensive workflows. AI-assisted systems may help integrate data acquisition, interpretation, and decision support within a more unified framework, potentially

accelerating discovery and improving analytical reproducibility. Looking ahead, the convergence of AI, advanced instrumentation, robotics, and intelligent sensing technologies may lead to autonomous analytical systems capable of supporting real-time decision-making and adaptive experimental design. Such developments could further shorten the path from data generation to scientific insight and expand the accessibility of advanced analytical technologies. The future analytical laboratory may evolve from a data-generating facility into an intelligent knowledge-generation system, where AI serves not merely as a computational tool but as a collaborative partner in scientific discovery.

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Computational and machine learning approaches for the identification of unknown chemicals by mass spectrometry



Han Bin Oh

Department of Chemistry, Sogang University, Republic of Korea

Biographical Sketch

Professor Han Bin Oh received his B.S. degree from Seoul National University in 1993 and his Ph.D. from the University of Toronto in 2001. He conducted postdoctoral research at Cornell University from 2001 to 2003 and has been a faculty member at Sogang University since 2003. His research focuses on mass spectrometry, machine learning, and toxicology. He served as Editor-in-Chief of Mass Spectrometry Letters (2018-2019) and the Journal of the Korean Chemical Society (2023-2024). He also served as Executive Vice President for General Affairs of the Korean Chemical Society (2024-2025). His work integrates advanced analytical sciences with data-driven approaches to address challenges in chemistry and life sciences.

Abstract

The chemical space of potential organic compounds is extraordinarily vast, encompassing far more molecules than can be experimentally characterized. In contrast, tandem mass spectrometry (MS/MS) data are available for only a small fraction of known chemicals, creating a significant bottleneck in the identification of unknown compounds encountered in chemical, pharmaceutical, forensic, and toxicological analyses. Although substantial efforts have been devoted to addressing this challenge, the reliable identification of unknown chemicals remains one of the most important unsolved problems in mass spectrometry.

Our research focuses on narrowing the relevant chemical space and leveraging computational and machine learning approaches to facilitate the identification of unknown chemicals. In particular, we develop strategies for generating virtual chemical libraries, predicting tandem mass spectra using machine learning models, and constructing virtual MS/MS databases that can be used for the annotation and identification of previously uncharacterized compounds.

A major application area of this work has been the identification of emerging illicit substances, including novel phosphodiesterase type 5 (PDE5) inhibitor analogs and new psychoactive substances (NPS), in collaboration with the Korean Ministry of Food and Drug Safety (MFDS). By exploiting the relatively constrained chemical spaces associated with these compound classes, we generate virtual candidate structures, develop machine learning-based MS/MS prediction models, and construct virtual spectral databases to support the detection and identification of compounds for which experimental reference spectra are unavailable.

Recent advances in generative modeling have opened new opportunities for exploring previously uncharted regions of chemical space. We are actively investigating how these emerging technologies can be integrated with mass spectrometry workflows to further improve the identification of unknown chemicals. In this symposium, we will share our recent developments, methodologies, and applications, highlighting the potential of computational

and machine learning approaches to advance unknown chemical identification by mass spectrometry.

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Data-Driven Design of 2D Materials for Electrochemical Applications

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12120, Thailand



Biographical Sketch

Assoc. Prof. Dr. Pawin Iamprasertkun is specialised in 2D materials, electrochemistry, and machine-learning-driven materials design, with over 80 papers published in society journal. He is outstanding Young Researcher at Thammasat University (2023). He has received major national/international awards including the Merck-CST-TYCN Award (2025), Outstanding Young Nanotechnologist Award (2025), Sheelagh Campbell Award (2019), Royal Society of Chemistry-UK, Anglo-Thai Academic Excellent Award (2019).

Abstract

Understanding the characteristics, both physical and electrochemical, of two-dimensional (2D) materials is crucial for the advancement of various electrochemical devices such as energy storage systems, electrocatalysts, ions selective membranes, and wastewater treatment technologies. To achieve this goal, controlled synthesis of 2D materials plays a vital role. In this study, we focus on the structural control achieved through liquid phase exfoliation of bulk materials, specifically: (i) **graphite-graphene**, (ii) **transition metal dichalcogenides**, and (iii) **heterostructure formation**. This involves material handling techniques and recycling of waste generated during the synthesis process. Furthermore, the exfoliated materials were utilised in diverse applications including supercapacitors (including electrode materials and binders), electrocatalysts, and removal of ions for wastewater treatment. To delve deeper into the complex realm of materials science and electrochemistry, we **incorporated data science methodologies** such as machine learning and statistical tools. Through simple data analysis, valuable electrochemical insights were derived, paving the way for the design of machine learning algorithms-an innovative approach in this field. To the best of our knowledge, this integration of data science as well as the materials synthesis in the context of 2D materials holds great potential for their development and application in various fields.



Figure 1. Schematic showing the overall research work.

References

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Publishing for Impact

Zhanhao HU
Royal Society of Chemistry



Biographical Sketch

Zhanhao is the Assistant Editorial Development Manager at the Royal Society of Chemistry (RSC). He oversees publications from Japan & Korea regions and engages with local researchers and editors. Zhanhao holds a PhD in Materials Physics and Chemistry and previously worked as a post-doctoral researcher at Okinawa Institute of Science and Technology (Japan). Before joining the RSC, he gained a few years of experience in the industry. He is a Member of the Royal Society of Chemistry (MRSC).

Abstract

The Royal Society of Chemistry is the world's leading chemistry community with the mission to advance excellence in the chemical sciences. We are a leading international publisher, publishing 58 journals covering all areas of chemical sciences, with an archive of content dating back to 1841. Supported by a worldwide network of over 54,000 members and an international publishing business, our activities span education, conferences, science policy and the promotion of chemical sciences to the public. The Royal Society of Chemistry has offices in Japan, USA, Germany, China, India and Brazil.

In addition to introducing the Royal Society of Chemistry, this presentation will give an overview of scientific publishing, covering the key information you need to know about publishing your research effectively. We will share with you some of our top tips on how to write your paper, pick an appropriate journal, and with that, publish with impact.

Poster Number List

Flash Presentation1 Poster Session1

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Flash Presentation3	09:30-10:15
Poster Session3	13:30-14:30

The diagram illustrates the experimental setup for a multi-agent system. It features a rectangular arena with a dashed border. Inside, there are two rows of 12 seats each, facing each other. A central table is positioned between the rows. A camera is mounted on a stand at the top center, with a field of view indicated by a cone. A small robot is positioned on the table. The arena is divided into three sections by a central vertical line. The left and right sections are labeled 'P1' and 'P3' respectively, and the central section is labeled 'P2'. The seats are numbered 01 to 32 in a grid pattern. The table is labeled 'K10'.

Entrance

Flash Presentations & Poster Sessions

RSC-JAIMA Symposium on Analytical Chemistry 2026

Makuhari Messe, Chiba, Japan, September 3-4, 2026.

P1 Poster Session

P1-01 Electric Field Simulation Results of Nanoelectrode Arrays for Dielectrophoresis Analysis

Chiang, Chia-Hsuan¹, Shiau, Jeng-Huei² and Cheng, Chao-Min¹

¹ Institute of Biomedical Engineering, National Tsing Hua University, Hsinchu, Taiwan ² NEAT Biotech Inc., Hsinchu, Taiwan

P1-02 Temperature-Resolved Differentiation and Quantification of Carbon in LFP Cathode Materials via C/S Analysis

Hongtaek Kim¹, Mai Sakaguchi², Jaehyun Yoo³, Yasunobu Okada⁴, Yujeong Park⁵, Sangwoon Park⁶

^{1,3,5} Scientific, HORIBA Korea Ltd., Anyang, Republic of Korea ^{2,4} Analytical Technology Division, HORIBA Techno Service Co., Ltd., Kyoto, Japan ⁶ R&D Division, HORIBA Ltd., Kyoto, Japan

P1-03 Hierarchical CNT-MOF Nanocomposite on Laser-Induced Graphene for High-Performance Antibiotic Sensing

Muhammad Sarkawi¹, Divya Naradasu², K. S. Shalini Devi², Kazuto Sazawa², Hideki Kuramitz^{1,2}

¹ Graduate School of Science and Engineering, University of Toyama ² Department of Natural and Environmental Sciences, Faculty of Science, Academic Assembly, University of Toyama

P1-04 Dual-Mode Colorimetric/Photothermal Lateral Flow Immunoassay for Salmonella Typhimurium

Kantawit Kaewchairueang¹, Pattarachaya Preechakasedkit², Wanida Tangkawsakul², Nipapan Ruecha^{2,3}

¹ Graduate Program in Nanoscience and Technology College of Interdisciplinary and Integrative Studies, Chulalongkorn University, Bangkok, Thailand ² Metallurgy and Materials Science Research Institute, Chulalongkorn University, Bangkok, Thailand ³ Center of Excellence for Food and Water Risk Analysis (FAWRA), Department of Veterinary Public Health, Faculty of Veterinary Science, Chulalongkorn University, Bangkok, Thailand

P1-05 Multimodal Imaging of Renal Tissue using Infrared, Raman and Mass Spectrometry

Anna Zetterström^{1,3}, Nicholas Lockyer^{2,3}, Peter Gardner^{1,3}

¹ Department of Chemical Engineering, University of Manchester ² Department of Chemistry, University of Manchester ³ Photon Science Institute, University of Manchester

P1-06 Comparative Characterization of Green-Synthesized TiO₂ Nanoparticles Using Aqueous and Ethanolic Extracts of Passiflora edulis Peel and Preliminary Evaluation of Their Photocatalytic Activity Against Sulfamethoxazole

Roni Saputra^{1,2}, Safni Safni¹, Rahmayeni Rahmayeni¹, Refilda Refilda¹, Mega Gemala¹

¹ Department of Chemistry, Faculty of Mathematics and Natural Sciences, Andalas University, Padang, Indonesia ² Faculty of Health Sciences, Ibnu Sina University, Batam, Indonesia

P1-07 Development of a cost-effective thin-film microextraction analytical device for the detection of agrochemicals from water

Harshika Poojary¹, Chiranjit Ghosh¹,

¹ School of Civil and Chemical Engineering, Manipal Institute of Technology, Manipal Academy of Higher Education (MAHE), Karnataka, India.

P1-08 The Acceleration of Microplastic Measurement and Analysis using Infrared Microscope

Kazuki Sobue¹, Kazumi Kawahara¹, Naoya Fujiwara¹, Riki Kiano¹

¹ Shimadzu Corporation

P1-09 Mn Speciation in Freshwater Pearls and Synthetic Mn-bearing Aragonite: Insights into Biomineralization Processes

Ryota Masuda¹, Michio Suzuki², Akiko Hokura³

¹ Graduate School of Engineering, Tokyo Denki University ² Graduate School of Agricultural and Life Sciences, The University of Tokyo ³ Department of Applied Chemistry, Tokyo Denki University

P1-10 Interfacial Polarity-Regulated Mechanical Strengthening in MXene-Polypeptide Nanofibrous Membranes

Yu-Yuan Ku¹, Yu-Ching Huang^{2,5}, Po-Chun Chen¹, Meng-Fang Lin², Tsui-Yun Chung², Yu-Ting Lin², Wen-Han Tsao², Kiyotaka Sasagawa³, Jun Ohta⁴, Wei-Fang Su²

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P1-11 Arduino-Controlled Absorption Microspectroscopy Utilizing Hadamard Transform

Yukei Kawakami¹, Nobuo Uehara¹, Arinori Inagawa¹

¹Graduate School of Regional Development and Creativity, Utsunomiya University, Japan

P1-12 All-solid-state electrode for potentiometric chloride detection in biological fluids

Gia-Linh Huynh¹, Kanyapat Teekayupak², Nipapan Ruecha²

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P1-13 Identification of Extractables from Pharmaceutical Packaging by Using GC-MS with EI and Soft Ionization

Nanako Kato¹, Azusa Kubota¹, Masaaki Ubukata¹,

¹ JEOL Ltd.

P1-14 High-sensitivity Raman measurements in flow systems

Sarina Mine¹, Koji Inada², Takayoshi Ota², Kohei Tamura¹, Satoe Iijima¹, Ken-ichi Akao¹, Hirotsugu Hiramatsu³

¹ JASCO Corporation, ² JASCO Engineering, ³Department of Applied Chemistry, National Yang Ming Chiao Tung University

P1-15 Cost-effective, disposable paper-based MXene-coated sampling tool for metabolic profiling to identify *Klebsiella pneumoniae* bacterial pathogen

Chiranjit Ghosh¹, Debsmita Mandal¹, Author Name^{1,2}

¹ School of Civil and Chemical Engineering, MIT-Manipal, Manipal Academy of Higher Education, India

P1-16 Association of Casein during Freezing of a Phosphate Buffer

Keisuke Shoji¹, Nobuo Uehara¹, Arinori Inagawa¹

¹Graduate School of Regional Development and Creativity, Utsunomiya University, Japan

P1-17 3D Imaging-Based Quantification of Porous Materials: Sheet-Like, Particulate, Composite, and Virtual Structures

TAKI Katsuhiko¹, KOGA Harumichi¹, MASUGI Ayano¹

¹ Nihon Visual Science, Inc.

P1-18 Microfluidic System Combining Microgrooved Polymeric Sheets and Lattice Microchannels for Efficient CTC Capture and Detection

Tatsuki Kobayashi, Shin Ozawa, Rie Utoh, and Masumi Yamada

Graduate School of Science and Engineering, Chiba University

P1-19 FRET Fluorescent Dye Liquid Nano-droplets as Labeling Reagents for Competitive Assay Toward High-Sensitivity Biosensing

Naoya Noda¹, Yoshiki Soda¹, Tatsuro Endo¹, Hideaki Hisamoto¹

¹ Graduate School of Engineering, Osaka Metropolitan University

P1-20 Electrical Conductance of a Single DNA Molecule Modified with a Functional Molecule

Harunari Okura¹, Tomoaki Nishino¹

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P1-21 Performance Comparison of Cationic and Anionic Marker Ions in a Laser-Induced Graphene-Based Potentiometric Aptasensor for *Escherichia coli* Detection

Chalinee Auanphui¹, Pattarachaya Preechakasedkit², Nanthika Khongchareonporn⁴, Nipapan Ruecha^{2,3}

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P1-22 Investigation of quantitative performance in fluorescence spectrophotometric measurement using open-channel paper-based microfluidic devices as thin-layer cuvettes

Asuka Sato¹, Naoki Hirayama², Kotaro Morita²

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P1-23 Evaluation of noise reduction in high-speed WDS spectral imaging

Yasuteru Nawafune¹, Koki Kato¹, Fuyuki Nabeshima¹

¹ JEOL Ltd., Tokyo, Japan

P1-24 Construction of a Streptavidin Modified ZnO nanowires coated Magnetic Beads for the Analysis of Cancer-Derived Extracellular Vesicles

Wentao Zhang¹, Taiga Ajiri², Kunanon Chattrairat², Takao Yasui^{1,2}

¹Institute of Science Tokyo, Japan ²Nagoya University, Japan

P1-25 Absolute quantitative analytical method “effective magnetic moment method” based on Curie-Weiss law

*Nobuhiro Matsumoto*¹

¹ National Metrology Institute of Japan, National Institute of Advanced Industrial Science and Technology

P1-26 Development of 3D-Printed Molecularly Imprinted Polymer Platforms for Analytical Applications

*Ryo Kakegami*¹, *Yohei Tanifuji*¹, *Yuki Hiruta*¹, *Citterio Daniel*¹

¹ Department of Applied Chemistry, Keio University

P1-27 Co-culture of Cells Derived from Small Intestinal Organoids and Vascular Endothelial Cells to Develop an Intestinal Model for Analyzing Drug Metabolism

*Aika Takayama*¹, *Takayoshi Ito*², *Hisako Kayama*³, *Kiichi Sato*¹

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P1-28 Time-Course Alcian Blue Signal Analysis and Simplified Kinetic Interpretation of Biofilm Formation on Dual-Periodic Nanostructures

*Chien, Li-An*¹, *Lin, Chung-Hsiang*², *Lee, Kang-Yuan*², *Cheng, Chao-Min*

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P1-29 Electronic transitions in the nucleotide using attenuated total reflection far-ultraviolet spectroscopy

Yuri Yanagihara, *Yusuke Morisawa*

Kindai University

P1-30 HPLC-Based Quasi-Thermodynamic Analysis of Interactions between Organofluorine Compounds and Neutral Small Molecules

*Shogo Nishimura*¹, *Yao Li*², *Akihito Hibara*¹

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P1-31 Highly Sensitive Optical Detection of Bacteria Using Metal-Organic Nanohybrids

*Satoshi Itagaki*¹, *Koki Takenaga*¹, *Yojiro Yamamoto*¹, *Hiroshi Shiigi*¹

¹ Department of Applied Chemistry, Osaka Metropolitan University

P1-32 An Origami Paper-Based Electrochemical Aptasensor for Neuropeptide Y Detection in Clinical Samples

*Sirajit Rayanasukha*¹, *Passakorn Pomngoen*¹, *Chawin Srisomwat*¹, *

¹ Department of Chemistry, Faculty of Science and Technology, Thammasat University, Pathum Thani, 12120, Thailand.

P1-33 Cell Disruption using Surface-Modified Porous PDMS Sponges Natsumi Kitaya¹, Daigo Chigira¹, Ryoma Fukuoka¹, Yukiko Moriwa¹, Kazuhiro Morioka¹,

*Tomofumi Fujino*¹, *Ryo Ishihara*², *Akio Yanagida*¹, *Atsushi Shoji*¹

¹ Graduate School of Pharmacy, Tokyo University of Pharmacy and Life Sciences ² Faculty of Medicine, Juntendo University

P1-34 Charge-Based Classification of Extracellular Vesicle Subpopulations Using ZnO Nanowire-Integrated Microfluidic Sukprasert Sararit^{1,2}, Kunanon Chattrairat², Taiga Ajiri², Takao Yasui^{1,2}

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² Graduate School of Engineering, Nagoya University.

P2 Poster Session

P2-01 Mechanical evaluation of photo-crosslinkable phospholipid membranes at fluid interfaces and their correlation with cellular adhesion

*Hongxin Wang*¹, *Junhong Zhou*², *Jun Nakanishi*²

¹ School of Science and Technology, Gunma University ² Research Center for Macromolecules and Biomaterials, National Institute for Materials Science (NIMS)

P2-02 Hydration Structure Measurement at the Boron-Doped Diamond Electrode-Electrolyte Interface Using Electrochemical AFM with Three-Dimensional Force Mapping.

*Kotaro Koizumi*¹, *Ryoya Otsuka*², *Kazuhiro Miyamura*¹, *Naritaka Kobayashi*²

¹ HORIBA Advanced Techno, Co., Ltd. ² Univ. of Shiga Prefecture

P2-03 3D-Printed Hydrogels for pH-Responsive Wound Infection Theranostics

*Thitiyaporn Phookum*¹, *Tatiya Siripongpreda*², *Karl Albright Tiston*³, *Pawinee Rerknimitr*⁴, *Charles S. Henry*⁵, *Benjaporn Narupai*⁶, *Nadnudda Rodthongkum*^{7*}

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P2-04 Factors Blurring Endpoint in the Redox Titration of Vanadium in Steel and Their solution

Taishi Kitamura¹, Arinori Inagawa¹, Nobuo Uehara¹

¹ Graduate School of Regional Development and Creativity, Utsunomiya University, JAPAN

P2-05 An Electrochemical Aptasensor for Cortisol Detection Based on DNAzyme Signal Amplification and Hairpin Aptamer Strategy

Passakorn Pomngoen¹, Sopon Butcha¹, Utid Suriya², Chawin Srisomwat^{1,}*

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P2-06 Selective Dye Adsorption of Deep Eutectic Solvent-Based Cellulose Porous Materials

Nafira Alfi Zaini Amrillah¹, Tsugufumi Matsuyama¹, Aster Rahayu², Lee Wah Lim¹

¹ Graduate School of Engineering, Gifu University, Japan ² Department of Chemical Engineering, Ahamd Dahlan University, Indonesia

P2-07 Integrated Lateral Flow Strip for On-Device CRISPR/Cas12a-Based Colorimetric Nucleic Acid Detection

Akihiro Takahashi¹, Yuichi Okamoto¹, Yohei Tanifuji¹, Yuki Hiruta¹, Daniel Citterio¹

¹ Department of Applied Chemistry, Keio University

P2-08 Portable On-Site Detection of Paraquat Using a Carbon Nanotube/Cobalt-MOF Electrochemical Sensor

Fariqhatul Fitria¹, K.S. Shalini Devi², Divya Naradasu², Kazuto Sazawa^{1,2}, Hideki Kuramitz^{1,2}

¹ Graduate School of Sustainability Studies, University of Toyama ² Department of Natural and Environmental Sciences, Faculty of Science, Academic Assembly, University of Toyama

P2-09 Electrochemical Immunosensor for Non-Invasive Salivary TNF- α Detection.

Rujira Phumma¹, Thidarut Laochai², Richard W. Vachet³, Thantrira Porntaveetus⁴, Mutsumi Kimura⁵, Sarute Ummartyotin^{2,6,7}, Patanachai K. Limpikirati^{8,9,}, Naddu Rodthongkum ^{1,10,11*}*

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P2-10 Development and Electromechanical Characterization of PPyDBS-based Flexible Actuators for Enhanced Neural Interfaces

Chung-Yu Lo¹, Guei-Jhen Jhang¹, Kuang-Chih Tso², Yoshinori Sunaga², Kiyotaka Sasagawa², Jun Ohta², Po-Chun Chen¹

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P2-11 Optimal column selection for measurement of Experimental Polar Surface Area using supercritical fluid chromatography

Shotaro Hirota¹, Yusuke Masuda¹, Yasuhiro Funada¹, Ryo Kubota¹, Watabe Yoshiyuki², and Hidetoshi Terada¹,

¹ Shimadzu Corporation, Analytical & Measuring Instruments Division, Solutions COE ² Shimadzu General Services

P2-12 Raman Band Selection for Starch Determination During Postharvest Ripening of Banana

Nguyen Minh-Quan^{1,2}, Tsuta Mizuki², Kokawa Mito³

¹ University of Tsukuba, Graduate School of Technology and Science ² National Agriculture and Food Research Organization (NARO), Institute of Food Research ³ University of Tsukuba, Institute of Life and Environmental Sciences

P2-13 Comparative Characterization of Green-Synthesized TiO₂ Nanoparticles Using Aqueous and Ethanolic Extracts of Passiflora edulis Peel and Preliminary Evaluation of Their Photocatalytic Activity Against Sulfamethoxazole

Roni Saputra^{1,2}, Safni Safni¹, Rahmayeni Rahmayeni¹, Refilda Refilda¹, Mega Gemala¹

¹ Department of Chemistry, Faculty of Mathematics and Natural Sciences, Andalas University, Padang, Indonesia ² Faculty of Health Sciences, Ibnu Sina University, Batam, Indonesia

P2-14 Improved spatial resolution using phase recovery methods in pattern illumination time-resolved phase microscopy (PI-PM)

Ryutaro KOGAWA; Yoshua Albert Darmawan; Kenji KATAYAMA

¹ Department of Chemistry, Chuo University

P2-15 Green Synthesis of TiO₂ Nanoparticles using Archidendron pauciflorum (Jengkol) Peel Extract for Photocatalytic Degradation of Paracetamol Wastewater

Deliza Deliza¹, Indeswari Putri Budianto², Nur Ahmad³, Reza Audina Putri³ Khoiriah³, Safni Safni⁴

¹ Department of Chemistry, Faculty of Science and Technology, Universitas Islam Negeri Sulthan Thaha Saifuddin Jambi, Jambi 36361, Indonesia ² Department of Chemistry, Faculty of Science and Technology, Universitas Islam Negeri Syarif Hidayatullah Jakarta, Tangerang Selatan 15412, Indonesia. ³ Research Center for Catalysis, National Research and Innovation Agency (BRIN), Building 452 LST BJ Habibie, South Tangerang, Indonesia. ⁴ Department of Chemistry, Faculty of Mathematics and Natural Sciences, Andalas University, Limau Manis, Padang, West Sumatera, 25163, Indonesia

P2-16 A Self-Reporting Electrochromic Aptasensor for Label-Free Salivary Cortisol Detection Using a Smartphone-Readable Polyaniline Interface

Chawin Srisomwat^{1,}, Passakorn Pomngoen¹, Sasiprapa Tathong¹, Warawut Tiyapongpatana¹, Sopon Butcha¹, Supada Khonyoung¹*

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P2-17 MaiML: A Common Data Format for Measurement and Analysis and Its Application to an Autonomous Experimental System

Aiba Akira^{1,2}, Atsushi Ohbuchi^{1,3}, Kazuki Ito^{1,3}

¹ Rigaku Corp., Akishima, Tokyo, Japan, ² The Univ. of Tokyo., Bunkyo, Tokyo, Japan, ³ Japan Analytical Instruments Manufacturers' Association (JAIMA)

P2-18 Surface-Confined Molecular Imprinting on an Extended-Gate Organic Field-Effect Transistor for Oxytocin Sensing in Human Saliva

Muthukumar Govindaraj¹, Mallikarjuna Swamy Shabanur Matada¹, Yui Sasaki^{2,3}, and Tsuyoshi Minami^{1}*

¹ Institute of Industrial Science, The University of Tokyo, 4-6-1 Komaba, Meguro-ku, Tokyo 153-8505, Japan. ² Research Center for Advanced Science and Technology, The University of Tokyo, 4-6-1 Komaba, Meguro-ku, Tokyo 153-8904, Japan. ³ JST, PRESTO, 4-1-8 Honcho, Kawaguchi, Saitama, Japan.

P2-19 Relationship between mineral phases in steelmaking slag and leaching behavior of constituent elements under strongly acidic conditions

Yuki Soma¹, Arinori Inagawa¹, Nobuo Uehara¹

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P2-20 Surface Engineering of Exfoliated CoFe-LDH Nanosheets via Polydopamine-Anchored Ir³⁺ for Stable Seawater Oxidation

*Min Su Kwak, Jong Hyeon Lee**

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P2-21 Microstructural Analysis of Cellular Tunneling Nanotubes via Electrochemical Approaches

Kyoko Shibata¹, Hiroki Ida², Hiroya Abe^{1,3}, Yasufumi Takahashi², Kosuke Ino¹, Hitoshi Shiku¹

¹ Graduate School of Engineering, Tohoku University ² Graduate School of Engineering, Nagoya University ³ Frontier Research Institute for Interdisciplinary Sciences, Tohoku University

P2-22 Mechanochemical Behavior of Polytetrafluoroethylene Co-milled with Inorganic Salts

Yao Li¹, Hirano Kakeru², Junya Kano¹, Takeshi Hasegawa³, Motohiro Kasuya⁴, Mao Fukuyama¹, Akihito Hibara²

¹ Tohoku University, ² Institute of Science Tokyo, ³ Kyoto University, ⁴ Komatsu University

P2-23 The Preparation and Characterization of a ADP Sensor Based on Dipicolylamine-Copper(II)/Phenylboronic-acid Modified Cyclodextrin Inclusion Complex

Takeshi Hashimoto¹, Masaki Ishida¹, Shoji Fujiwara², Yuji Tsuchido³, and Takashi Hayashita¹

¹ Faculty of Science and Technology, Sophia University ² Faculty of Chemistry and Biochemistry, Kanagawa University ³ SIT Research Laboratories, Shibaura Institute of Technology

P2-24 Seeing Alumina Coating in a New Light: SEM-Raman-CL Synergy

Jinfeng Lu¹, Tamae Omoto¹, Yuhei Nakajima¹, Rie Wakimoto¹, Ryuichi Kato², Naoki Kikuchi¹

¹ JEOL Ltd. ² RENISHAW K.K.

P2-25 A Bioluminescence-Based Chemical Screening Method Using Printed Paper Microplate

Ryohei Nihongi¹, Shuma Kinugasa¹, Yuki Hiruta¹, Sung-Bae Kim², Daniel Citterio¹

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P2-26 Fabrication of cyclic peptide-immobilized Au screen-printed electrodes for cell sensing

Kazuharu Sugawara¹, Hideki Kuramitz²

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P2-27 A Mass Spectrometry-Based Method for the Analysis of Short Chain Hydroxy Acids in Small Volume Samples

Yi-Shan Li^{1,2}, Chi-Yu Lu^{1,2}

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P2-28 Development of Alkali Resistant Reversed Phase Column Packing Material Based on Eggshell Utilizing Layer-by-Layer Self-Assembly

Mai Kawamura¹, Koichi Deura¹, Naoya Takahashi¹, Daniel Citterio¹, Yuki Hiruta¹

1 Department of Applied Chemistry, Keio University

P2-29 A simple dip-strip colorimetric sensor for on-site screening of GHB/GBL contamination in beverages

Kanjana Kunpathee¹, Kurt Kalcher², Georg Raber^{2}, Sudkate Chaiyo^{1,3*}*

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P2-30 Development of Extracellular Vesicle Analysis Technology Using Functionalized Cellulose Nanofiber Sheets

Taiga Ajiri¹, Jun Sakaida¹, Kunanon Chattrairat¹, Takao Yasui¹

1 Nagoya University

P2-31 Laminated Microfluidic Paper-Based Analytical Device for Rapid Multiplex Water Quality Monitoring with Optimized Colorimetric Image Analysis Asmaa Salah¹, Ahmed A. Shalaby², Akihiko Ishida², Masatoshi Maeki², Manabu Tokeshi²

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P2-32 pH-Responsive Deep Eutectic Solvent Extraction for Preservative Analysis in Oily Samples

Fang-Yi Liao¹, Chia-Hsien Feng^{1}*

1 Department of Fragrance and Cosmetic Science, College of Pharmacy, Kaohsiung Medical University, Kaohsiung, Taiwan

P2-33 A Point-of-care Semi-quantitative Device for Rapid Urine Glucose Detection

Shunsei Uchibori¹, Kaori Yamanouchi², Taiki Kozasa², Yohei Tanifuji¹, Yuki Hiruta¹, Daniel Citterio¹

1 Department of Applied Chemistry, Keio University 2 Buddy Cloud Inc.

P2-34 Development of Functional Porous PDMS Sponge for Selective Recovery of Platinum Group Metals

Zhang Yang¹, Naokazu Idota², and Takehiko Tsukahara^{1, 2}*

1 Science Tokyo, School of Mater. Chem. Technol. 2 Science Tokyo, Zero-Carbon Energy

P3 Poster Session

P3-01 Membrane Characterization of Supported Lipid Bilayers for Cell Culture Applications

Ayuka Shimada¹, Nozomi Watanabe¹, Yukihiro Okamoto¹, Hiroshi Umakoshi¹

1 Graduate School of Engineering Science, Osaka University

P3-02 Dynamic Prediction of Cyclodextrin Complex Formation Using Machine Learning with UV-Vis Absorption Spectra

Yuichiro Anada¹, Yusuke Katsuwata², Takashi Nakada¹, Yuko Ueno², Katsuhiro Ajito¹

1 Department of Information Technology, International Professional University of Technology in Osaka, Japan 2 Graduate School of Science and Engineering, Chuo University, Japan

P3-03 Machine Learning Prediction of Binding Affinity for Alzheimer's Disease-Related Amyloid- β Proteins

Katsuhiro Ajito¹, Kong Lik Tung¹, Takeshi Yoshida¹, Yuko Ueno²

1 Department of Information Technology, International Professional University of Technology in Osaka, Japan 2 Graduate School of Science and Engineering, Chuo University, Japan

P3-04 Mid-infrared laser absorption spectroscopy with feature extraction for real-time, high-precision multi-component gas sensing

Shota Hamauchi¹, Takuya Ido¹

1 HORIBA, Ltd.,

P3-05 Analysis of aroma compounds in grated garlic using a structure analysis method utilizing machine learning

Marina Namba¹, Azusa Kubota¹, Yoshio Abe¹

1 JEOL Ltd.

P3-06 Development of Sustainable Nicotinic Acid-Functionalized Chito-Oligosaccharide Ti/Si Hybrid Monolithic Capillary Columns for Multifunctional Mixed-Mode and Chiral Separations

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P3-07 Multiple Ordered Solvent Environments in Lipid Membrane Investigated by DAN Probes

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P3-08 Distance-Based Capillary-Driven Microfluidic Devices for On-Site Coffee Analysis

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P3-09 Vascular Network Formation in a Perfused Well System

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P3-10 Flow Behaviors and Calculation Results of Capillary-Driven Flow in a Triangular Nanofluidic Channel with Heterogeneous Semiconductor Materials

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P3-11 An analytical MALDI-DIT-MS workflow for oligonucleotide therapeutics

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P3-12 Platinum Nanoflower-Based Electrochemical Sensors for Real-Time Cellular Activity Monitoring and Glucose Analysis

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P3-13 Molecular Dynamics Insights into NSAID Adsorption on a Hydrophobic Deep Eutectic Solvent-Coated Silica Sorbent

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P3-14 Analysis of the Effects of Intermolecular Interactions on the Electronic States of Liquid Alcohols by ATR-FUV Spectroscopy

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P3-15 Analysis of urushiol in Japanese lacquer sap

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P3-16 Green-Synthesized TiO₂ Nanoparticles from Annona muricata Peel Extract: Comparative Physicochemical Characterization and Preliminary Photocatalytic Evaluation Against Paracetamol

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P3-17 A Microfluidic Tumor Cell Spheroid Array for Parallel Evaluation of Nanoparticle Uptake

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P3-18 Integration of Preconcentration Chip with FET Biosensor for Acute Respiratory Distress Syndrome Detection

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P3-19 Ionic Liquid Chelate Extraction Behavior of Divalent Metal Ions with Acylpyrazolones

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P3-20 A Self-Exchanging Anthraquinone Gallery Reconstructs NiFe-LDH for Durable Oxygen Evolution in Chloride Electrolyte

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P3-21 Separating extracellular miRNA sources using nanowire thermofluidics for tumor-associated function identification

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P3-22 Development of Fluorescent Boronic Acid Probe for Biofilm Detection

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P3-23 Development of a Silica-Enhanced Multiplex Colorimetric PAD for Wastewater Monitoring

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P3-24 Precise Controls over Metallic Core-Shell Nanoarchitectures with 2-8 nm Shell Thickness in a Pseudosolid Phase

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P3-25 Development of a MOF-199/PDMS paper-based disposable microextraction device for rapid detection of pesticides from dry fruit.

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P3-26 Development of Oxygen Sensor Integrated Micro Intestinal Model with a Controlled Oxygen Gradient

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P3-27 Paper-Based Analytical Device for Quantitative Detection of Salivary MMP-8 Toward Periodontal Disease Diagnosis

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P3-28 Development of a Hydrothermal Decomposition Pretreatment for the Determination of Polycarbonate by HPLC with Electrochemical Detection

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P3-29 Effect of Perfusion on Lipid Accumulation in a Microfluidic Renal Tubule Model Mimicking Diabetic Nephropathy-Associated Lipid Metabolic Dysfunction

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P3-30 Quantitative evaluation of Shodoamide C as the potentiator of membrane pore formation using the microfluidic liposome array

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P3-31 Barcode-Based Paper Analytical Device for Point of Care Testing

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P3-32 Measurement-Template Workflow for Human-in-the-Loop Quantification in 2D/3D Imaging-Based Research

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P3-33 Green-Synthesized TiO₂ Nanoparticles from Annona muricata Peel Extract: Comparative Physicochemical Characterization and Preliminary Photocatalytic Evaluation Against Paracetamol

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P3-34 Development of a Chemically Modified PDMS Membrane for Stretch Cell Culture

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Electric Field Simulation Results of Nanoelectrode Arrays for Dielectrophoresis Analysis

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This study uses the electric field simulation to investigate how nanoelectrode array structures influence dielectrophoresis-based analytical platforms. Dielectrophoresis enables capture and separation of microorganisms. However, electrode geometry, applied voltage, waveform, applied frequency, and non-uniform electric field distribution strongly influences the dielectrophoresis performance. Therefore, computational simulation can reduce the time and trial-and-error required for experimental optimization.

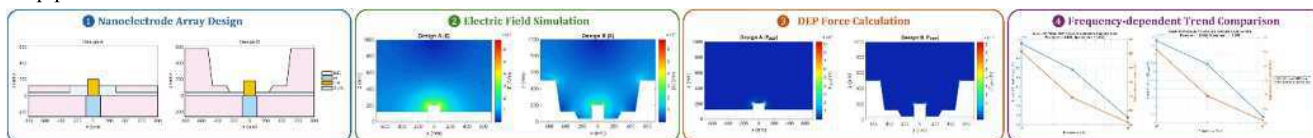
We established a simulation-guided workflow using MATLAB R2025b to evaluate the electric field distribution and dielectrophoresis driving capability of different nanoelectrode designs. First, we built a 2D cross-sectional model based on the electrode geometry and boundary conditions, and then calculated the potential distribution using the Laplace equation (1). The electric field vector was obtained from the negative gradient of the electric potential (2), and the electric field magnitude (3) was simulated.

$$\nabla^2 V = 0 \quad (1) \quad E = -\nabla V \quad (2) \quad |E| = \sqrt{E_x^2 + E_y^2} \quad (3)$$

To evaluate the dielectrophoresis effect, we simulated the spatial gradient of the squared root-mean-square electric field, $\nabla|E|^2$, as an index of dielectrophoresis driving capability. We further calculated the dielectrophoresis force (F_{DEP}), where r was the particle radius, ϵ_m was the permittivity of the medium, and $Re[K(\omega)]$ was the real part of the Clausius–Mossotti factor (as below).

$$F_{DEP} = 2\pi r^3 \epsilon_m Re[K(\omega)] \nabla|E|^2 \quad (4)$$

The simulation results show that electric-field intensity mainly concentrates near the edges and gap regions of activated electrodes. Under an applied voltage of 20 Vpp, the maximum electric-field magnitude reached 6.81×10^7 V/m and generated a calculated dielectrophoresis force on the order of 10^{-4} N. Different nanoelectrode structures also changed the spatial distribution of high-electric-field regions and dielectrophoresis force - active regions. Furthermore, the frequency-dependent trend of the calculated dielectrophoresis force agrees with the relationship between dielectrophoresis capture efficiency and frequency observed in previous experiments using the same chip platform.



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Temperature-Resolved Differentiation and Quantification of Carbon in LFP Cathode Materials via C/S Analysis

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Abstract LiFePO₄ (LFP) cathode materials require surface carbon coating to overcome their intrinsically low electronic conductivity, making accurate quantification of carbon content and carbon species a key quality control (QC) parameter for electrochemical performance and mass production. However, oxidative TGA can underestimate carbon content because carbon combustion-induced mass loss may be offset by mass gain from Fe²⁺ oxidation to Fe³⁺. Solid TOC analysis also has limitations in decomposing and recovering carbon from certain inorganic carbonate species.

Herein, we applied a temperature-programmed step mode of C/S analytical method for the temperature-resolved separation and quantification of carbon in LFP cathode materials. Stepwise heating enabled differentiation of low-temperature carbon from residual solvents or impurities, mid-temperature carbon associated with binder-derived or organic components, and high-temperature carbon attributed to coating carbon and inorganic carbon species. LFP samples thermally treated from 300 °C to above 500 °C were further characterized by Raman spectroscopy, XPS, SEM-EDS, XRF, and GD-OES to cross-validate changes in carbon structure, surface chemistry, morphology, elemental composition, and depth-dependent carbon distribution.

This method provides reliable carbon-species-resolved quantification while minimizing the influence of oxidation-induced mass changes in the LFP matrix. The proposed approach can be utilized as a practical analytical platform for carbon coating quality evaluation and advanced QC in LFP cathode production.

Keywords: LiFePO₄ cathode; carbon coating; C/S analysis; Step mode; quality control

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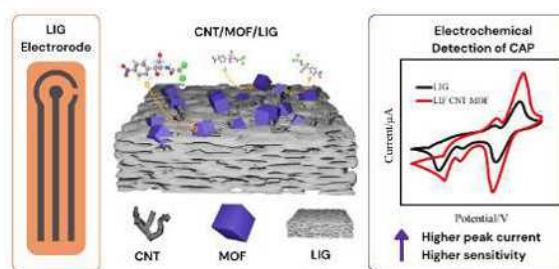
Hierarchical CNT–MOF Nanocomposite on Laser-Induced Graphene for High-Performance Antibiotic Sensing

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Abstract Chloramphenicol (CAP) is a broad-spectrum antibiotic extensively used in clinical and veterinary applications. Excessive use of CAP can result in severe health complications. Conventional analytical techniques such as HPLC and GC–MS offer excellent sensitivity but suffer from high operational cost, time-consuming, and limited portability. Therefore, rapid and sensitive monitoring of CAP residues is critically important for environment, public health and food safety. This study aims to develop a sensitive electrochemical sensor based on a laser-induced graphene (LIG) electrode modified with a carbon nanotube/metal–organic framework (CNT/MOF) nanocomposite for CAP detection. A CNT/MOF composite was synthesized through in situ growth of cobalt-based MOF on CNT surfaces. The CNT/MOF was then drop-cast onto laser-induced graphene (LIG) electrodes and dried to fabricate the modified sensing platform. Structural and morphological characterization was conducted using FTIR, SEM-EDX, and XRD. Electrochemical performance was evaluated using cyclic voltammetry (CV) and differential pulse voltammetry (DPV) under optimized fabrication and sensing conditions. The developed CNT/MOF/LIG electrode demonstrated enhanced electrochemical activity compared with the bare LIG electrodes due to the synergistic effect of conductive CNT networks and porous MOF active sites. The sensor showed diffusion-controlled electrochemical behavior and achieved a low detection limit of 1.08 μM with good linearity. The CNT/MOF/LIG electrochemical sensor offers a promising platform for rapid, sensitive chloramphenicol detection.



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Dual-Mode Colorimetric/Photothermal Lateral Flow Immunoassay for *Salmonella* Typhimurium

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Salmonella Typhimurium is one of the leading causes of foodborne illness worldwide and remains a major concern for public health and food safety. Therefore, the development of rapid, sensitive, and portable detection methods is essential for effective pathogen monitoring and outbreak prevention. This study aimed to develop a dual-mode colorimetric/photothermal lateral flow immunoassay (LFIA) for rapid and sensitive detection of *Salmonella* Typhimurium. The nanocomposite of gold and platinum (Au@Pt) were employed as multifunctional nanoprobes due to their excellent optical properties and high photothermal conversion efficiency. The colorimetric signal was quantified through red intensity analysis, while the photothermal signal was evaluated by monitoring temperature changes under laser irradiation. The analytical performance of both detection modes was investigated and compared under optimized experimental conditions. The developed LFIA achieved detection limits of 10^5 CFU/mL and 10^4 CFU/mL in the colorimetric and photothermal modes, respectively. Compared with conventional colorimetric detection, the photothermal approach provided a 10-fold improvement in sensitivity. In addition, the dual-mode strategy enabled rapid visual screening together with enhanced quantitative sensitivity, thereby improving the reliability of pathogen detection. The proposed dual-mode LFIA demonstrates strong potential as a rapid and sensitive point-of-care platform for *Salmonella* Typhimurium detection. The integration of colorimetric and photothermal detection enhances analytical performance and may contribute to improved food safety surveillance and early-stage bacterial detection.

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Multimodal Imaging of Renal Tissue using Infrared, Raman and Mass Spectrometry

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Chemically specific imaging techniques, such as vibrational spectroscopy and mass spectrometry imaging (MSI) applied to biological tissue have seen an increasing interest in recent years. Multimodal imaging combining these techniques across spatial scales generates complimentary information, promising a better understanding and explainability of the chemistry of the tissue [1]. In this work we have used both vibrational spectroscopy and mass spectrometry-based modalities to provide chemical maps ranging from the micron to sub-micron scale on renal cancer tissue. Fourier-transform infrared (FTIR) imaging and quantum cascade laser infrared (QCL-IR) imaging enable rapid, label-free assessment of broad chemical distributions at micron resolution, while optical photothermal infrared (O-PTIR) and stimulated Raman scattering (SRS) imaging provide sub-micron spatial resolution. These vibrational techniques are complemented by desorption electrospray ionization mass spectrometry imaging (DESI-MSI), which delivers molecularly specific information on lipids, metabolites, and other small molecules from the tissue, but at significantly poorer spatial resolution, see figure 1. Here we discuss the challenges associated with multimodal analysis with greatly differing spatial resolution and dynamic range. We assess analysing different data individually and combining results compared to analysing the combined data. The results are discussed in terms of explainable AI and increased diagnostic accuracy.

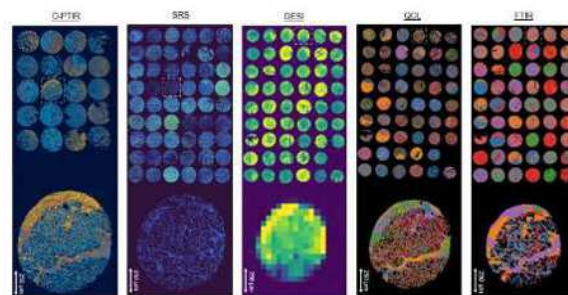


Figure 1. Comparison of O-PTIR, SRS, DESI, QCL and FTIR imaging.

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Comparative Characterization of Green-Synthesized TiO₂ Nanoparticles Using Aqueous and Ethanolic Extracts of Passiflora edulis Peel and Preliminary Evaluation of Their Photocatalytic Activity Against Sulfamethoxazole

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Abstract

Introduction Sulfamethoxazole (SMX), a persistent sulfonamide antibiotic, is a recalcitrant aquatic contaminant that resists conventional wastewater treatment and contributes to antimicrobial resistance [1]. TiO₂-based photocatalytic advanced oxidation offers an effective remediation route. Green synthesis via plant extracts is a sustainable and low-hazard alternative to conventional methods; yet the role of extraction solvent polarity on TiO₂ properties remains underexplored, especially using tropical bioresources such as Passiflora edulis peel.

Aim This study comparatively synthesizes and characterizes TiO₂ nanoparticles mediated by aqueous (EA) and ethanolic (EE) extracts of P. edulis peel, and provides a preliminary evaluation of their photocatalytic activity against SMX.

Methodology TiO₂ nanoparticles were prepared via sol-gel using titanium(IV) isopropoxide (TTIP), mediated by EA and EE extracts of dried P. edulis peel. Both samples were characterized by XRD, FTIR, UV-DRS (Tauc plot), and FESEM-EDS. Photocatalytic activity was evaluated against 25 mg/L SMX under UV-C ($\lambda = 254$ nm) and monitored spectrophotometrically at 257 nm.

Results Both samples exhibited the anatase phase by XRD. Key characterization results are shown in Table 1. Notably, TiO₂-EA showed primary crystallites four times smaller than TiO₂-EE (10.4 vs. 41.8 nm), indicating stronger crystal growth inhibition by polar phytochemicals [2]. UV-DRS Tauc plots revealed meaningful bandgap narrowing only in TiO₂-EA (3.28 vs. 3.37 eV). FTIR confirmed phytochemical surface capping in both samples. In preliminary photocatalytic tests, TiO₂-EA outperformed TiO₂-EE and UV-only controls in SMX removal, consistent with its smaller crystallite size and larger accessible surface area.

Conclusion Aqueous extraction of P. edulis peel produced TiO₂ nanoparticles with markedly superior properties: four-times-smaller primary crystallites, a lower bandgap (3.28 vs. 3.37 eV), and stronger preliminary photocatalytic activity against SMX [3]. Extraction solvent polarity is thus a critical determinant of biogenic TiO₂ performance, with broader implications for sustainable photocatalyst design in antibiotic wastewater remediation.

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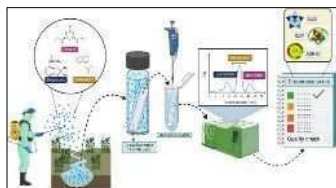
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Development of a cost-effective thin-film microextraction analytical device for the detection of agrochemicals from water

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Abstract: Agrochemicals are widely used during the farming process to protect crops from pests and improve agricultural productivity. These pesticides accumulate in regular water sources, posing potential hazards to the environment and human health. To simplify the detection of agrochemicals, thin-film solid-phase microextraction (TF-SPME) analytical devices were developed which is both cost effective and sensitive. The results showed that TF-SPME patches were able to extract pesticides with a LOD of 0.1 ng/mL. The developed technique aligned with the green analytical principles due to low solvent use, minimal waste generation, and energy efficiency. The AGREE score emphasized its strong connection with green chemistry, while complex GAPI and BAGI validated its environmental compatibility and user safety. This microextraction TF-SPME device may be applicable for the rapid quantification of agrochemicals from water resources to safeguard human lives [1-3].



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The Acceleration of Microplastic Measurement and Analysis using Infrared Microscope

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Tiny plastic on the order of several μm to 5 mm are referred to as microplastics (MPs). MPs are widely recognized as a marine environmental problem, and international standardization (ISO 16094 [1], etc.) of analytical methods for MPs is progressing. Since relatively large MPs (300 μm or larger) are pretreated and picked up one by one to observe the shape with a stereomicroscope. MPs are identified by the ATR method using a fourier transform infrared spectrophotometer (FTIR) [2]. On the other hand, small MPs (approximately 100 μm to 20 μm) need to be pretreated as necessary, collected on a filter, and measured with an infrared microscope. When there are many candidate MPs particles on a filter, it is necessary to measure a large area and check and identify the shape of each particle individually. Since these operations require a lot of time, the function of measurement (High-Speed mapping) and analysis program (the particle analysis program) were developed.

To speed up the measurement time, the optimized mapping algorithm was applied in the software. In normal mapping, the measurement time becomes longer as the measurement area becomes large. In High-Speed mapping, the program detects based on data from the first scan at each measurement point and the specified noise level and threshold value settings. If no peak is confirmed, the program moves to the next measurement point. In this way, even if a large area is set, the measurement time is shortened because only the area with particles is measured. The standard MPs on a Si filter were measured an area of about 2 mm square using High-Speed mapping. It takes about 20 hours with normal mapping, on the other hand with High-Speed mapping, the measurement was completed in 2.5 hours.

To speed up analysis, the particle analysis program was developed. Conventionally, it was necessary to confirm the size of each particle and identify it by spectral research, and it took as much time as the number of particles to analysis. The particle analysis program reads the spectrum of the plastic to be identified, and can identify the plastic in a batch. The size (major/minor diameter, Feret diameter, etc.) of the identified particles is automatically calculated. Estimated values for mass and volume are also calculated [3]. Histograms of the number and size of each plastic can also be displayed automatically, speeding up analysis.

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Mn Speciation in Freshwater Pearls and Synthetic Mn-bearing Aragonite: Insights into Biomineralization Processes

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Freshwater pearls contain significantly higher concentrations of manganese (Mn) than marine pearls [1]. Although the nacreous layer is mainly composed of aragonite, Mn^{2+} is generally considered difficult to accommodate in the aragonite lattice because of the difference in ionic radius between Mn^{2+} and Ca^{2+} . Therefore, the chemical state and retention mechanism of Mn in freshwater pearls remain unclear. Proposed forms of Mn in nacre include Mn-rich calcite-like nanodomains within aragonitic nacre [2] and interactions with organic matrices in the nacreous layer [3]. In this study, Mn-bearing aragonite was synthesized as a model material and compared with freshwater pearls using Mn K-edge X-ray absorption near-edge structure (XANES) analysis to investigate the local chemical environment of Mn.

Aragonite was synthesized by stirring a mixed solution of 50 mM CaCl_2 (20 mL), 1 M MgCl_2 (5 mL), and 50 mM Na_2CO_3 (10 mL) at room temperature at 200 rpm for one week. Crystal phases were identified by powder X-ray diffraction (XRD). Mn-bearing aragonite was synthesized by adding MnCl_2 to the precursor solution at initial Mn concentrations ranging from 1.37×10^{-3} to 1.37 ppm. Additional syntheses were performed in the presence of ascorbic acid to suppress Mn oxidation during crystal growth. Mn concentrations in the products were quantified by XRF, and crystal morphologies were observed by SEM.

Powder XRD (Cu $K\alpha$ radiation) confirmed the formation of Mn-bearing aragonite at Mn concentrations up to 1.37 ppm. At higher Mn concentrations, aragonite was no longer observed, while rhodochrosite (MnCO_3) and other crystalline phases formed. Mn K-edge XANES analysis indicated that the synthesized Mn-bearing aragonite contained Mn species with oxidation states higher than +2, suggesting partial oxidation of Mn during synthesis. In samples synthesized with ascorbic acid, both Mn valence states and crystal growth were strongly affected. Insufficient ascorbic acid resulted in the coexistence of higher-valent Mn species, whereas excess ascorbic acid inhibited calcium carbonate crystal growth. Under optimized Mn and ascorbic acid conditions, the Mn K-edge XANES spectra of synthetic Mn-bearing aragonite exhibited Mn(II)-like features closely matching those of freshwater pearls. However, these spectra did not completely agree with that of Mn-calcite, suggesting that Mn in freshwater pearls cannot be explained solely by a simple Mn-calcite-like environment.

This work was performed using analytical instruments at the TDU Analysis Center. Synchrotron radiation experiments were conducted with the approval of the Photon Factory Program Advisory Committee (Proposal No. 2024G612).

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RSC-JAIMA Symposium 2026, Makuhari Messe, Chiba, Japan, September 3-4, 2026.

Interfacial Polarity-Regulated Mechanical Strengthening in MXene-Polypeptide Nanofibrous Membranes

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Abstract

This research investigates how interfacial polarity governs the mechanical response of $\text{Ti}_3\text{C}_2\text{T}_x$ MXene-polypeptide composites across a homologous series of electrospun polypeptide nanofibrous films spanning a controlled polarity gradient: hydrophobic PBG, intermediate-polarity PBGA15, and highly hydrophilic 7CBZL3BG. Three mechanistically distinct reinforcement regimes are identified. The hydrophobic PBG system undergoes aggregation-driven mechanical deterioration attributed to severe polarity mismatch, whereas PBGA15 achieves strength-dominated reinforcement through efficient interfacial load transfer, and 7CBZL3BG exhibits ductile toughening mediated by dynamic, reversible interfacial sliding. The universality of this polarity-governed framework is corroborated through external validation with commercial PCL and PVA reference systems. Furthermore, all composite films demonstrate excellent cytocompatibility, with aligned fibrous architectures offering effective contact guidance for PC-12 cellular orientation. In this study we findings establish interfacial polarity matching as a decisive and generalizable design parameter for engineering MXene-based nanofibrous composites with tailored mechanical and biological functionality.

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RSC-JAIMA Symposium 2026, Makuhari Messe, Chiba, Japan, September 3-4, 2026.

Arduino-Controlled Absorption Microspectroscopy Utilizing Hadamard Transform

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Abstract Hyperspectral imaging (HSI) enables the acquisition both of spectroscopic and geometrical information. However, the conventional HSI requires wavelength or spatial scanning, limiting measurement speed. To address this issue, we developed a Hadamard transform-based absorption microspectroscopy. A multi-wavelength LED was modulated in accordance with Hadamard mask patterns controlled by Arduino. Transmission images were then acquired under multiplexed illumination. Spectra were reconstructed by applying the transpose of the Hadamard matrix to the measured data for each ROI. Herein, we employ the BTB solutions at various pH values as sample solutions. We applied this methodology for the measurement of the samples in a conventional cuvette and microfluidic channels to show its feasibility.

Experimental A multi-wavelength LED light source was equipped under the microscope stage. A sample cell containing the solution was placed on the stage, and microscopic images were acquired using a CCD camera while each LED element was sequentially illuminated according to the Hadamard mask patterns. The mask pattern was derived from the Hadamard matrix. In this study, BTB solutions adjusted to pH 5.0–8.0 were used as the samples. RGB analysis was then performed on the captured images. The absorbance at each wavelength was reconstructed from the grey scale values of the images by Hadamard transform.

Results and Discussion Figure. 1 shows the absorbance calculated by the Hadamard transform at each pH. As references, the spectra acquired with a conventional spectrophotometer was also measured, shown as the solid lines. The reconstructed absorbance was identical to the spectra. In contrast, single wavelength measurements overestimated the absorbance of BTB at high pH because of the reduced number of photons reaching CCD camera. In contrast, simultaneous illumination in the Hadamard method increased the number of photons reaching to the CCD camera, which reduces the S/N ratio. These results demonstrate the feasibility and advantages of Hadamard transform-based microscopic absorption spectroscopy.

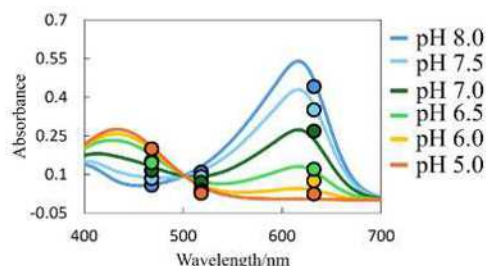


Fig. 1 Comparison of BTB absorbance obtained by the Hadamard transform and spectrophotometry.

RSC-JAIMA Symposium on Analytical Chemistry 2026, Makuhari Messe, Chiba, Japan, September 3-4, 2026.

All-solid-state electrode for potentiometric chloride detection in biological fluids

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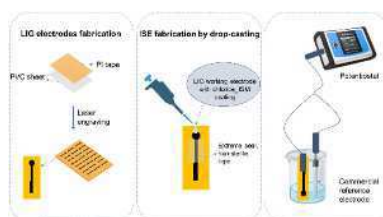


Figure. Graphical abstract

Chloride ions (Cl^-) are critical electrolytes in human physiology, with concentrations in biological fluids such as sweat (10–100 mM) and urine serving as clinically relevant biomarkers for cystic fibrosis diagnosis, dehydration monitoring, and renal function assessment. There is a growing need for flexible, miniaturized electrochemical sensors capable of real-time Cl^- monitoring in wearable or portable devices. This work presents a flexible, all-solid-state potentiometric chloride ion-selective electrode (ISE) fabricated on a polyimide/poly(vinyl chloride) (PI/PVC) substrate, using laser-induced graphene (LIG) as the solid-contact transducer layer and a PVC-based ion-selective membrane (ISM) incorporating Chloride Ionophore II (ETH 9009). LIG electrodes were produced by direct CO_2 laser scribing of PI tape laminated onto

flexible PVC substrates (160 mm/s, 9 mm focal distance), yielding a porous, highly hydrophobic 3D graphitic network that suppresses the interfacial water layer and mitigates potential drift. The ISM was formulated by dissolving Chloride Ionophore II (2.00 wt%), ETH500 (0.03 wt%), DOS (64.97 wt%), and PVC (33.00 wt%) in cyclohexanone (10–25 wt%), deposited by sequential drop-casting of five layers, with 0.3 μL per layer. OCP measurements were performed against a commercial Ag/AgCl reference electrode using a PalmSens4 potentiostat over NaCl concentrations from 10^{-7} M to 1 M. The LIG-based ISE exhibits a well-defined Nernstian response toward Cl^- , with enhanced potential stability and selectivity compared to screen-printed Ag/AgCl electrodes. With its high sensitivity, repeatability, and cost-effective flexibility, the developed device is perfectly suited for clinical point-of-care diagnostics and wearable patch integration.

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RSC-JAIMA Symposium 2026, Makuhari Messe, Chiba, Japan, September 3-4, 2026.

Identification of Extractables from Pharmaceutical Packaging by Using GC-MS with EI and Soft Ionization

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Abstract

Leachables are compounds that migrate from packaging into pharmaceutical products under actual use or storage conditions. Extractables are compounds released under harsh conditions and are potential Leachables. Comprehensive and accurate characterization of extractables is essential for identifying chemical components that may affect pharmaceutical product quality.

In this study, extractables obtained by direct thermal extraction and solvent extraction were both analyzed using GC-MS, followed by integrated qualitative analysis [1], including database searches of EI measurement data, verification of molecular ions and isotope ratios in both EI and Soft Ionization (SI) measurements, and evaluation using the Retention Index (RI).

As a result, Extractables originating from resin additives and manufacturing residues were detected in the TICCs obtained from both solvent extraction and direct thermal desorption. Although the detected amounts varied depending on the compound, Direct thermal desorption tended to detect a larger number of components than solvent extraction. These compounds were identified through integrated analysis, indicating highly reliable qualitative results. Furthermore, for compounds not registered in the NIST database, structure analysis using machine learning [2] was performed, and 3- (2,4-di-tert-butyl-3-hydroxyphenyl) propanol was estimated as a top candidate. This compound is presumed to be a degradation product of the additive, as it contains a partial structure of an antioxidant that was confirmed to be present in this sample. Thus, the estimation is considered reasonable.

Based on these findings, integrated qualitative analysis of GC-MS data acquired using both EI and SI could be useful for the safety evaluation of pharmaceutical packaging materials.

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RSC-JAIMA Symposium 2026, Makuohari Messe, Chiba, Japan, September 3-4, 2026.

High-sensitivity Raman measurements in flow systems

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We have previously worked on Raman monitoring of flow systems, including a qualitative analysis of flow synthesis of pharmaceuticals. Raman spectroscopy is a powerful technique capable of analysis based on molecular vibrations, and its ability to measure real-time, on-site spectra makes it highly suitable for *in-situ* and online measurements. However, it suffers from low sensitivity due to the inherently low intensity of Raman scattered light. At the RSC-JAIMA Symposium 2024, we reported a flow monitoring system using surface-enhanced Raman scattering (SERS), which achieved increased sensitivity [1]. Nevertheless, challenges remained regarding quantitative analysis and substrate durability for repeated use. To overcome these issues, this study investigated high-sensitivity flow measurements using the vertical flow (VF) method as a new approach for sensitivity enhancement [2]. The VF method confines light by utilizing total internal reflection at an air-liquid interface, thereby drastically improving the collection efficiency for scattered light. In this work, we fabricated a new VF flow cell and evaluated its performance by integrating it into a commercial Raman microscope (JASCO NRS-4500). For validation, 2 wt% methylparaben dissolved in a 1:1 (v/v) mixture of acetonitrile and water was used as a sample, and the measurement results were compared using this method and a conventional square cuvette. The sample was introduced using a pump at a flow rate of 3 mL/min. Measurements were performed at an excitation wavelength of 532 nm, a laser power of 80 mW, an exposure time of 5 msec, and 200 accumulations. The results showed that the peak at 849 cm⁻¹, assigned to the solute, was approximately 38 times higher than that obtained with a conventional square cuvette, indicating a significant improvement in sensitivity.

This sensitivity enhancement on a millisecond time scale provides an improved S/N ratio and a higher time-resolution. The details of the system and the measurement results will be reported at the presentation.

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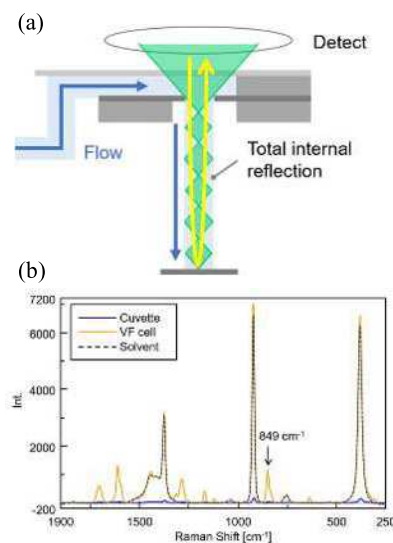


Fig. (a) Structure of VF cell
(b) Comparison of Raman spectra measured with VF cell and cuvette

RSC-JAIMA Symposium 2026, Makuohari Messe, Chiba, Japan, September 3-4, 2026.

Cost-effective, disposable paper-based MXene-coated sampling tool for metabolic profiling to identify *Klebsiella pneumoniae* bacterial pathogen

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Abstract: *Klebsiella pneumoniae* (*K. pneumoniae*) is responsible for hospital-acquired respiratory infections, especially in immunocompromised individuals. Rapid identification of *K. pneumoniae* is required for effective antibiotic treatment and combating antibacterial resistance. Here, cellulose paper-based Ti₃C₂T_x MXene/divinylbenzene-coated microextraction patches were designed for extracting metabolites from the culture media of *K. pneumoniae* (ATCC 13883). To fabricate the patches, an automated film applicator was used, and multiple pieces of sampling patches were obtained from a single coated sheet. The validation of the sampling tools was performed using McReynolds standards. The patches extracted fifty-seven metabolites from the log phase of the bacterial pathogen after triple-quadrupole gas chromatography mass spectrometry analysis. This technique achieved a greenness score of 72.5 (BAGI), indicating its eco-friendly analytical workflows. The fabricated microextraction is cost-effective, portable, and biocompatible. This may be used to provide a rapid platform for fast identification of *K. pneumoniae* from biological sample matrices. This technique may facilitate the extraction of metabolites from active bacterial pathogens in culture media, whereas traditional PCR is limited in differentiating between active and dead bacteria. Culture-based identification of bacteria is time-consuming. Therefore, these disposable paper patches could be used as a sampling kit for non-invasive pathogen detection in the future.

References: Literature information in order to refer to the research is strongly recommended [1-3].

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RSC-JAIMA Symposium 2026, MakuHari Messe, Chiba, Japan, September 3-4, 2026.

Association of Casein during Freezing of a Phosphate Buffer

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Introduction When an aqueous solution is frozen, phase separation occurs, generating pure ice crystals and a highly concentrated solution, so-called freeze concentrated solution (FCS). FCSs have been reported to induce reaction acceleration and to have unique physicochemical natures. The pH shift of a neutral phosphate buffer on freezing has attracted considerable attention from researchers in various fields.¹ Although a phosphate buffer has been utilized as a stabilizer for biological samples, the pH shift might affect the high-order structure of biopolymers. In this study, we investigated the conformational changes of casein during the freezing process of a phosphate buffer. Casein has been reported to change its structure depending on pH. We monitored the conformation changes using 8-anilino-1-naphthalenesulfonic acid (ANS), a fluorescent probe that binds to hydrophobic regions of proteins. A phosphate buffer containing casein and ANS was frozen, and the fluorescence spectra of ANS in the FCS were continuously measured. We then evaluated the intermolecular association induced by the structural change during the freezing process.

Experimental A casein-ANS-NaH₂PO₄/Na₂HPO₄ solution adjusted to pH 7.0 was frozen on a Peltier unit at -15 °C. The unit was installed in the chamber of a fluorescence spectrophotometer.

We measured the fluorescence spectra of ANS every minute during the freezing process. The intensity change was compared with the pH change of the FCS monitored by microscopic observation.

Results and Discussion Fig. 1 shows both the changes in the fluorescence intensity and pH of the FCS during the freezing process. The fluorescence intensity was normalized by the sample enrichment factor. In the 100 mM phosphate buffer, the fluorescence intensity around 470 nm increased as freezing progressed, while the pH of the FCS changed from neutral to acidic. This increase in fluorescence intensity suggests that conformational changes in casein exposed hydrophobic regions, resulting in increased binding of ANS. In contrast, the fluorescence intensity remained constant with the 1 mM phosphate buffer, suggesting that the pH change had little effect on casein. These results thus indicate that the pH change in the FCS during the freezing process has induced the association of casein.

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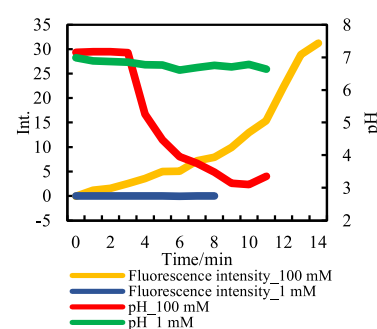


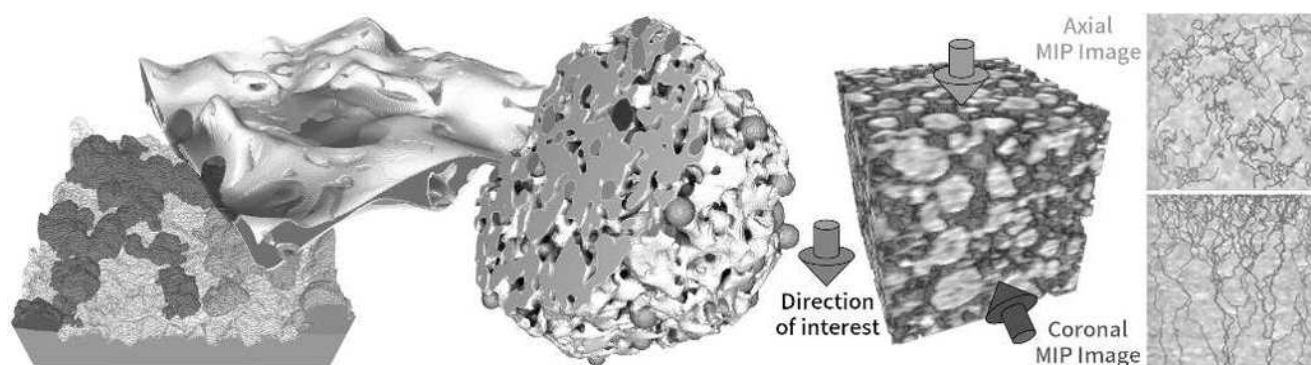
Fig. 1 Time-dependent changes in FCS pH and ANS fluorescence intensity
Maximum fluorescence wavelength: 470 nm

3D Imaging-Based Quantification of Porous Materials: Sheet-Like, Particulate, Composite, and Virtual Structures

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Abstract This presentation introduces practical software methods and case studies for analyzing diverse porous materials from 3D imaging data. The workflow applies tailored measurement methods to sheet-like, particulate, composite, and virtual structures, with a focus on the meaningful interpretation of complex interconnected pore structures. It extracts structural features and outputs clear metrics, visualizations, graphs, and numerical tables for sample comparison, material function analysis, and characterization.



RSC-JAIMA Symposium 2026, Makuhari Messe, Chiba, Japan, September 3-4, 2026.

Microfluidic System Combining Microgrooved Polymeric Sheets and Lattice Microchannels for Efficient CTC Capture and Detection

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Graduate School of Science and Engineering, Chiba University

Detection of circulating tumor cells (CTCs) in blood samples is essential for early cancer diagnosis and prediction of prognosis. Various strategies utilizing immunoreactions have been developed for selective CTC capture [1,2]. However, previous approaches often require complex and costly processes for antibody immobilization and substrate fabrication. In this study, we developed a novel CTC capture device that integrates a polycarbonate (PC) sheet with microgroove structures into a microfluidic device. A lattice microchannel for size-based cell separation [3] was further connected upstream of the device to achieve pre-enrichment and improve CTC capture efficiency (Fig. 1).

Microgrooved PC sheets were fabricated using a belt sanding device. Anti-EpCAM antibody solution was then deposited and dried on the surface to immobilize the antibodies. The PC sheet was sandwiched between a glass slide and a PDMS layer containing a microchannel structure to construct the CTC capture device. The device was connected to the lattice microchannel using a plastic tube.

In experiments, diluted human blood samples spiked with MCF-7 cells were used as a model. Using the capture device alone at a flow rate of 20 $\mu\text{L}/\text{min}$, the capture efficiency and selectivity were 63% and 45%, respectively. Using the integrated system, blood cells and MCF-7 cells were successfully separated in the lattice microchannel. At a flow rate of 20 $\mu\text{L}/\text{min}$, the capture efficiency was increased to 75%. Even when the input flow rate was increased to 40 $\mu\text{L}/\text{min}$, high capture efficiency was maintained. In addition, capture selectivity of the integrated devices was improved under all tested conditions compared with the capture device alone. These results suggest that the upstream lattice microchannel effectively removed blood cells prior to capture, thereby enhancing CTC capture performances. The proposed integrated system demonstrates its potential utility for CTC detection and diagnosis.

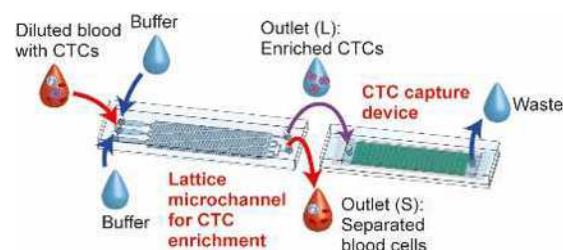


Fig. 1 Concept of the integrated CTC capture system with a microgrooved sheet and a lattice microchannel

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RSC-JAIMA Symposium 2026, Makuhari Messe, Chiba, Japan, September 3-4, 2026.

FRET Fluorescent Dye Liquid Nano-droplets as Labeling Reagents for Competitive Assay Toward High-Sensitivity Biosensing

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¹ Graduate School of Engineering, Osaka Metropolitan University

• Introduction

The capillary-type enzyme-linked immunosorbent assay (ELISA) developed by our research group allowed simple operation with small amount of sample, however, faced challenges regarding sensitivity and analysis time.^[1] On the other hand, we recently developed ultra-high-brightness nano-oil droplets that exhibit fluorescence enhancement approximately 20 times greater than those prepared by conventional methods by utilizing Förster resonance energy transfer (FRET) based on fluorescent dye liquid.^[2] In this study, we focused on the surface modification of these nano-oil droplets with molecular recognition capabilities and attempted to apply them to a competitive assay. As a proof of concept, we used the biotin for droplet surface modification and demonstrated competitive assay of free biotin by using avidin-modified glass surface.

• Experiments

Acceptor dye ([DTASP-12][TFPB]), donor dye liquid (Bis-6,10-Cm), surfactant (F127), biotin-modified F127 were dissolved in THF, which was then mixed with ultrapure water; the THF was subsequently removed to prepare a dispersion of biotin-modified nano-oil droplets with a particle size of approximately 180 nm. Biotin was added to this dispersion to achieve a final concentration of 0-10 μ M. Mixtures at each concentration were introduced into streptavidin-modified glass capillaries, and competitive assays were performed.

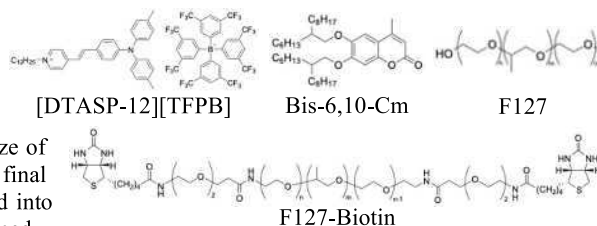


Fig. 1 Chemical structures of droplet components

• Results and Discussion

Fluorescence microscopy analysis revealed a high-intensity signal in the capillary with a biotin concentration of 0 μ M, whereas a clear decrease in signal intensity was detected at 10 μ M, demonstrating that biotin detection by competitive assay principle is possible using this system. These results demonstrate the suitability of FRET fluorescent dye liquid nano-droplets as labeling agents for competitive assays, and by replacing the molecules modified with surfactants, a wide range of applications for the detection of various target proteins is expected.

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RSC-JAIMA Symposium 2026, Makuhari Messe, Chiba, Japan, September 3-4, 2026.

Electrical Conductance of a Single DNA Molecule Modified with a Functional Molecule

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[Introduction] A single molecular junction (SMJ), composed of molecule bridging metal electrodes, has unique electron transport properties best suited for ultimately miniaturized electronic devices. DNA has been a promising component of these devices because of its superior electron transport properties arising from the π -stacking structure of the bases. Although it has been known that the electron property of DNA can be modulated by inserting intercalating molecules [1], functional control by modification of DNA-strands has not been investigated. Here, we studied electrical conductivity of a single DNA molecule whose strand bears covalent modification with a redox-active methylene blue moiety (MB-DNA, **Fig.1**), and the functionality of MB-DNA as an electronic component.

[Experiment] A sample surface was prepared by immersing an Au (111) substrate in a 1 μ M solution of the DNA for 45 min. DNA-based SMJs were repeatedly created using scanning tunneling microscope (STM), and thousands of conductance traces were collected. All conductance measurements were conducted in an electrochemical environment based on four-electrode system.

[Results and Discussion] **Fig.2** shows the 2D histogram of electrical conductance evolution as a function of STM tip displacement for MB-DNA. The conductance value of MB-DNA was determined to be $10^{-3.5}G_0$ ($G_0 = 77.5 \mu$ S). This value is slightly lower than that of reference DNA without MB residue, suggesting that overall π -stacking structure of the bases is preserved even after the MB modification. This conclusion is further supported by spectroscopic measurements and molecular dynamics simulations. Next, we investigated the conductance dependence on electrode potential. The conductance value of MB-DNA reaches a maximum around the redox potential of MB while the reference DNA does not show any changes. This conductance change can be fitted with Kuznetsov-Ulstrup transport model [2], and is attributed to the electron transport involving the redox-active MB moiety. In conclusion, we successfully determined the conductance value of MB-DNA and demonstrated its functionality as single-molecule transistor.

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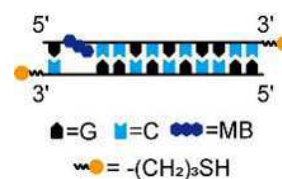


Fig.1 Structure of MB-DNA.

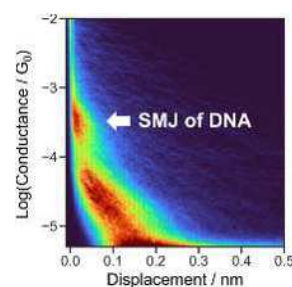


Fig.2 Conductance-Displacement 2D histogram of MB-DNA.

RSC-JAIMA Symposium 2026, Makuhari Messe, Chiba, Japan, September 3-4, 2026.

Performance Comparison of Cationic and Anionic Marker Ions in a Laser-Induced Graphene-Based Potentiometric Aptasensor for *Escherichia coli* Detection

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Foodborne illnesses caused by pathogenic microorganisms remain a major public health concern worldwide, with *Escherichia coli* (*E. coli*) being one of the most common contaminants in food and water. Rapid, sensitive, and reliable detection methods are therefore essential for effective food safety monitoring. This study developed a label-free laser-induced graphene (LIG)-based potentiometric ion-flux aptasensor for selective *E. coli* detection and compared the analytical performance of cationic and anionic marker-ion systems. The LIG electrode was fabricated by CO₂ laser engraving of polyimide tape and sequentially modified with marker ions, a five-layer carboxylated poly(vinyl chloride) (PVC-COOH) membrane, and an *E. coli*-specific aptamer. Tetrabutylammonium chloride (TBACl) and sodium tetrphenylborate (NaTPB) were used as cationic and anionic markers, respectively, to investigate the effect of marker-ion polarity on sensor performance. The sensing mechanism relied on changes in marker-ion flux across the PVC-COOH membrane following aptamer–target interaction. The developed aptasensor detected *E. coli* over a concentration range of 1–10⁴ CFU mL⁻¹, with a detection limit of 1 CFU mL⁻¹ and a response time of less than 10 min. The TBACl-based sensor exhibited higher sensitivity (11.883 mV decade⁻¹, R² = 0.9808) than the NaTPB-based sensor (11.079 mV decade⁻¹, R² = 0.9482), together with improved interface stability. The aptasensor also showed good reproducibility, high selectivity, and satisfactory recoveries of 85–107% in drinking water samples, with results comparable to the APHA 9221:2017 standard method. These findings demonstrate the potential of the proposed LIG-based potentiometric aptasensor as a rapid, portable, low-cost, and highly sensitive platform for on-site *E. coli* detection.

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RSC-JAIMA Symposium 2026, Makuhari Messe, Chiba, Japan, September 3-4, 2026.

Investigation of quantitative performance in fluorescence spectrophotometric measurement using open-channel paper-based microfluidic devices as thin-layer cuvettes

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In recent years, microfluidic paper-based analytical devices (μPADs) using paper as a substrate have been gaining attention as a low-cost and simple method of analysis. Conventional μPADs made from hydrophilic cellulose paper form channels through partial hydrophobization and deliver aqueous samples via capillary action. In contrast, our research group developed open-channel μPADs using hydrophobic polypropylene (PP) paper and seal tape as thin-layer cuvettes for absorbance measurements.[1] In this study, we further investigated its quantification performance in fluorescence spectrophotometric measurements with the standard addition and calibration curve methods.

We used a PC-controlled cutting machine (Silhouette Portrait 4, Silhouette America®) to cut channels into PP paper (Yupo Corporation, nominal thickness: 0.25 mm) and sealed both sides with sealing tape (AsOne, thickness: 50 μm, adhesive) to form paper-based thin-layer cuvettes. The paper thin-layer cuvette was installed into the filter slit on the sample holder of a fluorescence spectrophotometer (FP-8300, JASCO). The effect of the angle between the incident light angle and the sample surface (Fig. 1 (a)) on the fluorescence intensity, was examined in the range of $\theta = 15\text{--}75^\circ$.

When measuring fluorescence spectra with paper thin-layer cuvettes, the relationships were observed between the sample concentration and fluorescence intensity of uranin, pyranine, and flavin mononucleotide (FMN). We evaluated the quantitative performance of paper thin-layer cuvettes using the standard addition and the calibration curve methods. The concentration of FMN in a energy drink (nominal value 30 mg/100 mL) was overestimated to be 65.7±1.4 mg/100 mL using the standard addition method (Fig. 1 (b)). On the other hand, the calibration curve method gave a value of 31.9±0.6 mg/100 mL (Fig. 1 (c)), close to the nominal value, suggesting that quantitative analysis using the paper-based thin-layer cuvettes.

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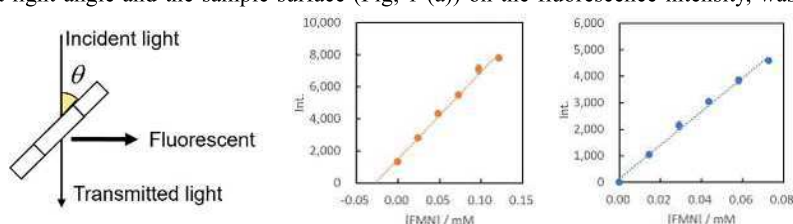


Fig. 1 (a) Schematic representation of optical arrangement of paper-based thin-layer cuvette in the sample chamber. Fluorescence intensity of FMN with (b) standard addition and (c) calibration curve methods.

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Evaluation of noise reduction in high-speed WDS spectral imaging

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Electron probe microanalyzer with wavelength-dispersive X-ray spectroscopy (EPMA-WDS) enables high-resolution elemental analysis; however, conventional analysis methods that do not utilize spectral imaging provide limited spectral information, restricting the obtainable analytical insights.

To address this issue, a WDS spectral imaging method has been developed by synchronizing data acquisition with WDS operation [1]. However, this approach requires long acquisition times, and in practice, high-speed spectral imaging with low X-ray counts is often necessary, making the data highly susceptible to statistical noise.

In this study, binning and principal component analysis (PCA) [2] were applied to the acquired spectral imaging data. By statistically decomposing and reconstructing the dataset, characteristic X-ray signals and background components were effectively separated, achieving noise reduction. This processing enables appropriate background correction and improves the visibility and analytical accuracy of trace components. Representative comparisons demonstrating improvements in both spectral imaging results and corresponding spectral data after denoising are shown in the figure.

These results indicate that the proposed method is effective for noise reduction in high-speed WDS spectral imaging, particularly under low-count conditions required for rapid data acquisition.

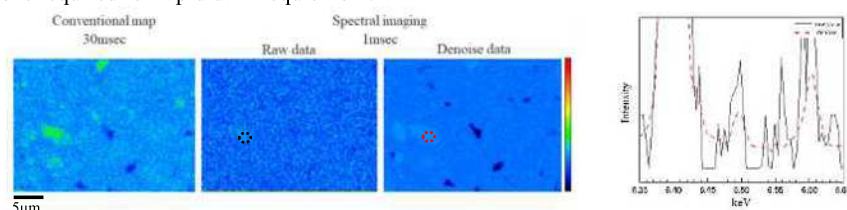


Figure. Comparison of a conventional map, raw spectral imaging data (before denoising) and the denoised map (after denoising) for trace Dy distribution in an Nd-Fe-B magnet sample (left). Corresponding spectra (black solid and red dashed lines) obtained from the marked same position in the raw and denoised dataset are shown (right).

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RSC-JAIMA Symposium 2026, Makuhari Messe, Chiba, Japan, September 3-4, 2026.

Construction of a Streptavidin Modified ZnO nanowires coated Magnetic Beads for the Analysis of Cancer-Derived Extracellular Vesicles

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Extracellular vesicles (EVs) have attracted growing interest as biomarkers for cancer diagnosis. However, conventional isolation methods such as ultracentrifugation are limited in recovering low-abundance EVs while preserving their integrity [1]. Our previous work demonstrated that ZnO nanowires can efficiently capture EVs [2], although their application has mainly been limited to microfluidic devices. Magnetic beads, by contrast, offer easy separation and a large surface area for probe immobilization. Therefore, this study aims to develop an efficient and non-destructive EV capture-and-release platform by combining ZnO nanowires with micrometer-scale magnetic beads, enabling faster detection even from samples with limited purity or low EV concentration.

ZnO nanowires were grown on seeded magnetic beads by a hydrothermal method using 30 mM hexamethylenetetramine, 30 mM zinc nitrate hexahydrate, and 1 mM polyethyleneimine at 95°C for 2 h, producing sea urchin-like structures. The nanowires were then coated with N-hydroxysuccinimide ester-functionalized polyketones (pKNHS) by solvent evaporation. As shown in our previous studies, pKNHS suppresses non-specific binding while providing reactive sites for protein conjugation [3]. Streptavidin monomers were subsequently coupled to NHS groups to enable immobilization of biotinylated proteins, while residual NHS groups were quenched with ethanolamine. It could be confirmed through SEM that we successfully reached a uniform ZnO nanowires growing on the ZnO pre-coated beads. Then, through FTIR, we could see a clear shift in the C=O stretching peak, suggesting the successful attachment of pKNHS onto the ZnO nanowires via coordination interactions. Using the TNBS-based colorimetric reaction with excess ethanolamine, combined with FTIR analysis, we further confirmed that streptavidin was successfully immobilized on the nanowire-coated beads. Because it could be clearly observed that there was a strong peptide bond peak at around 1655 cm⁻¹. Following this, we plan to design a capture-and-release platform based on current modified SPION via applying specific biotinylated probes on it. In addition, we will analyze clinical samples to explore whether each EV subpopulations exhibit distinct biological or clinical features.

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RSC-JAIMA Symposium 2026, Makuhari Messe, Chiba, Japan, September 3-4, 2026.

Absolute quantitative analytical method “effective magnetic moment method” based on Curie-Weiss law

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Various analytical instruments used for quantitative analysis must be calibrated using reference materials with known amounts of substances. The primary direct methods for measuring the amount of substance, which is defined in the ISO Guide35, are absolute quantitative analytical methods that enable the determination of the amount of substance without any reference to a standard.[1] Only three methods—gravimetry, coulometry, and dew-point depression—are recognized as the primary direct methods in the ISO Guide35:2006, as shown in Table 1. The development of new primary direct methods has the potential to establish novel approaches for accurate amount-of-substance measurements traceable to the International System of Units (SI). In this study, an absolute quantitative analytical method “the effective magnetic moment method” has been proposed. The “effective magnetic moment method” based on Curie–Weiss law enables the direct determination of the number of free spins of unpaired electrons, in a diamagnetic matrix. Examples of unpaired electrons are rare-earth ions, free radicals, and so on. In this presentation, principle, experimental method and applications of the effective magnetic moment method will be presented. Demonstrated applications include the quantification of rare-earth oxides and the accurate purity analysis of stable free-radical reagents. Additionally, preliminary attempt at the purity analysis of nitrogen monoxide will be presented in this poster session.

Table 1 Features of primary direct methods for amount-of-substance and “effective magnetic moment method”

	gravimetry	coulometry	freezing point depression method	“effective magnetic moment method” (This study)
academic field	inorganic chemistry	electro-chemistry	thermo-dynamics	magnetism
scientific law	—	Faraday’s law	Van’t Hoff equation	Curie-Weiss law
analyte	inorganic salt	metallic elements	pure organic liquid	atoms with unpaired electrons
equipment	balance	titration system	calorimeter	magnetometer

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Development of 3D-Printed Molecularly Imprinted Polymer Platforms for Analytical Applications

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Background 3D printing technology is attracting attention for its ability to enable flexible design and fabrication of complex structures. While traditionally developed as a prototyping tool, its application is now expanding toward the manufacturing of end-use products. This shift is driven by its capacity to balance global demands such as personalization and material efficiency with scalable production. In analytical chemistry, 3D printing has been reported for example for the fabrication of HPLC stationary phases¹ and adsorbents for Co²⁺ recycling², and its potential is increasingly being recognized.

Concept This study aims to develop an analytical platform integrating molecularly imprinted polymers (MIPs)³, functional materials with specific molecular recognition properties, with LCD-based 3D printing (Fig. 1). The goal is to demonstrate an adaptable platform that can be tailored to diverse analytical applications simply by modifying the design. In this study, an MIP with cavities specific for methylene blue (MB) was prepared by photopolymerization and 3D printing, using MB as model template.

Result For rapid screening, the 3D-printable formulation was first photopolymerized and ground into particles (Fig. 2a), achieving an IF of 2.4. Selectivity evaluation further confirmed specific recognition of MB. Evaluation of the 3D-printed MIPs (Fig. 2b) showed that the lattice structures provided performance comparable to that of the particle format.

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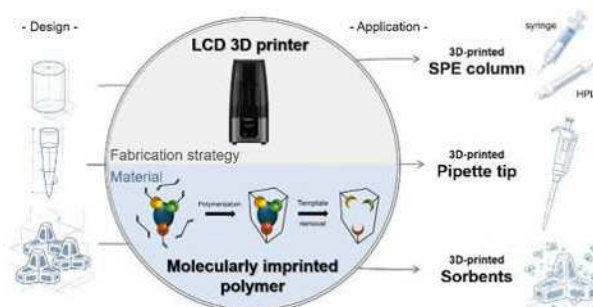


Fig. 1 Overview of the 3D-printed MIP platform: from design to application

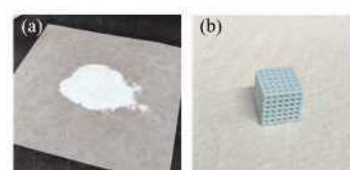


Fig. 2 (a)particle MIPs (b)3D-printed MIPs

Co-culture of Cells Derived from Small Intestinal Organoids and Vascular Endothelial Cells to Develop an Intestinal Model for Analyzing Drug Metabolism

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In the development of new drugs, an analysis of the absorption and metabolic processes in the small intestine is essential for accurately predicting the efficacy and safety of oral medications. Cytochrome P450 (CYP) a major drug-metabolizing enzyme, is expressed in small intestinal epithelial cells and is involved in the metabolism of many drugs, first-pass effects, and drug interactions. Therefore, evaluating CYP activity is a critical challenge in new drug development. In recent years, “Gut-on-a-Chip” technology which uses microfluidic chip technology to replicate the physiological microenvironment of the intestine has been developed, and its application to the evaluation of drug absorption and metabolism is highly anticipated. In vivo, drugs and metabolites absorbed and metabolized by small intestinal epithelial cells are transported throughout the body via blood vessels; therefore, an intestinal model that includes blood vessels is essential for reproducing these processes. Thus, in this study, we aimed to construct a micro-intestinal model capable of evaluating drug metabolism and investigated optimal co-culture conditions for cells derived from small intestinal organoids and vascular endothelial cells.

Figure 1 shows the microchip used in this study. The chip was fabricated by sandwiching a porous membrane between two PDMS sheets containing microfluidic channels. The upper and lower channels were designated as the intestinal side and the vascular side, respectively. Cells derived from small intestinal organoids were cultured on the upper surface of the membrane, while vascular endothelial cells were cultured on the lower surface of the membrane. To ensure successful co-culture of both cell types, we optimized co-culture conditions, including cell seeding density and culture duration, while perfusing the system with culture medium. Immunostaining and observation using a confocal microscope were performed to evaluate the differentiation of cells derived from small intestinal organoids. The results showed that the cells had differentiated into epithelial cells, and mucus secretion was also observed.

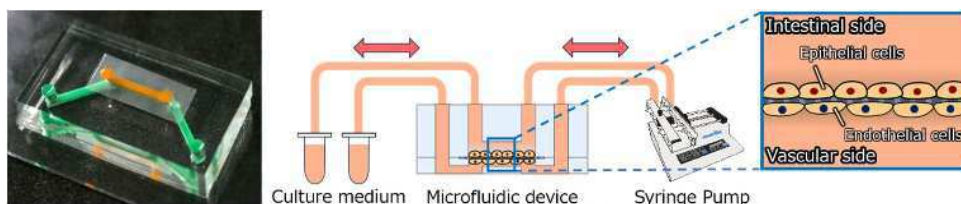


Fig. 1 Photograph and schematic diagram of the of the Gut-on-a-Chip

RSC-JAIMA Symposium 2026, MakuHari Messe, Chiba, Japan, September 3-4, 2026.

Time-Course Alcian Blue Signal Analysis and Simplified Kinetic Interpretation of Biofilm Formation on Dual-Periodic Nanostructures

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Biofilm formation on material surfaces remains a major challenge in biomedical and industrial applications. Nanostructures have been investigated as topography-based strategies for biofilm inhibition, but their effects on biofilm formation over time remain less clearly interpreted. This study evaluated polysaccharide accumulation on dual-periodic nanostructures and introduced a simplified framework for interpreting time-dependent signal changes.

A flat Blank control and dual-periodic H1/H2 nanostructures were used as test substrates. *Staphylococcus aureus* and *Pseudomonas aeruginosa* were cultured separately under biofilm-promoting conditions. Endpoint polysaccharide quantification based on Alcian Blue staining and sodium hyaluronate or sodium alginate calibration curves was first used to screen nanostructure-dependent inhibition. Based on this screening, H2 was selected for time-course Alcian Blue staining at 24, 48, 72, and 96 h, followed by ImageJ grayscale analysis.

H2 exhibited a more consistent inhibitory tendency among the dual-periodic nanostructures. For example, under 0.6% yeast extract with 1% glucose, H2 significantly reduced *S. aureus* polysaccharide-equivalent accumulation by 82.94 µg/mL compared with the Blank control (**p < 0.001, n = 3). The time-course profiles further showed that H2 altered polysaccharide-associated signal trajectories. Therefore, a simplified kinetic model, $\frac{dS}{dt} = k_{attach} + k_{accum} - k_{loss}$, was introduced to interpret the signal changes as the balance among attachment, accumulation, and late-stage loss. These findings suggest that dual-periodic nanostructures can modulate both final polysaccharide accumulation and its temporal progression.

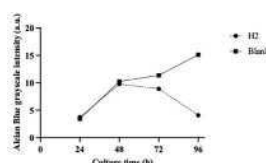


Figure 1. Representative time-course Alcian Blue grayscale intensity of *Staphylococcus aureus* associated biofilm formation on H2 and Blank control under 10% fetal bovine serum with 1% glucose.

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Electronic transitions in the nucleotide using attenuated total reflection far-ultraviolet spectroscopy

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Abstract The basic structures of DNA and RNA -deoxyribose, ribose, and the base- were measured in solution using attenuated total reflection far-ultraviolet spectroscopy (ATR-FUV). Since the obtained ATR-FUV spectra reflected both real and imaginary parts of refractive indices, necessitating a Kramers-Kronig transformation to extract the imaginary component. From this, the molar absorptivity was calculated using Lambert-Beer's law. Additionally, quantum chemical calculations were performed to assign the absorption bands of the electronic transitions. When compared with the ATR spectra of DNA and RNA, the absorption bands at 190 nm was attributed to the electronic transitions of base in DNA or RNA. According to the results of quantum chemical calculation, Ribose and Deoxyribose primarily undergo n-Rydberg transitions at around 160nm, while uracil was assigned n- π^* , π - π^* , and Rydberg transitions at around 250nm.

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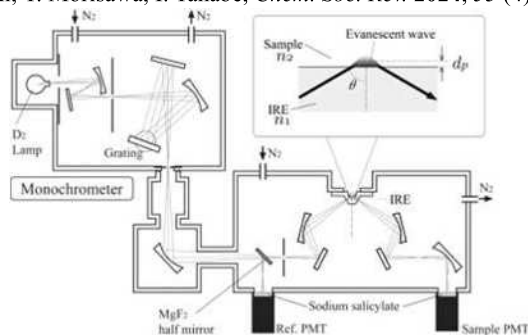


Figure 1 Schematic of the ATR-FUV

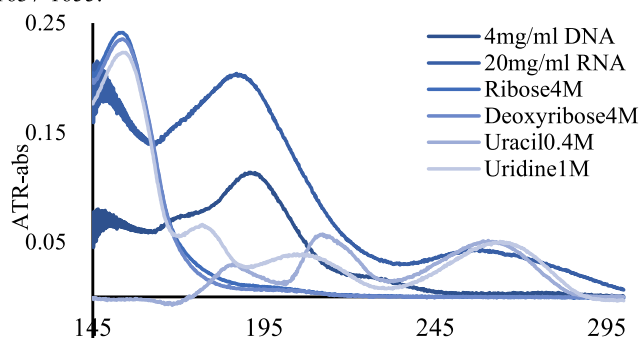


Figure 2 ATR-FUV spectra of measured samples

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HPLC-Based Quasi-Thermodynamic Analysis of Interactions between Organofluorine Compounds and Neutral Small Molecules

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Abstract Organofluorine compounds (PFAS) have been reported to exhibit bioaccumulative behavior. Therefore, evaluating their interactions with biomolecules (e.g., proteins, lipids, receptors...) is important for understanding the molecular basis of PFAS bioaccumulation. However, systematic profiling of these interactions is difficult because of the large number of possible combinations. Liquid chromatography offers a practical platform for this purpose: sparsely modified fluorinated chains can be used as a stationary phase, while various analytes can be rapidly compared. Sparse R_f5 column was designed to expose CF₂ dipoles at the interface [1]. Although direct analysis of biomolecules is difficult for their charges [2], we focused here on highly polar neutral small molecules as simplified model analytes.

In this study, we investigated the interaction characteristics of highly polar neutral small molecules with perfluoroalkyl-chain-modified stationary phases, focusing on quasi-thermodynamic analysis of retention. Four columns were compared: an octadecylsilane column, an unmodified silica column, a commercial densely modified perfluoroalkyl column, and a sparsely modified perfluoroalkyl column (Sparse R_f5) [2]. N-Methyl-2-pyrrolidone (NMP), and its analogs were used.

Retention measurements were performed using a water/methanol mobile phase at different temperatures. The retention factor was converted into an adsorption equilibrium constant, and its temperature dependence was analyzed using a van't Hoff plot. The enthalpic and entropic terms were then plotted to construct a quasi-thermodynamic plot. Sparse R_f5 column showed stronger retention for NMP-type compounds than any other columns. In particular, the difference in enthalpic contribution between the sparsely modified R_f5 and unmodified silica columns showed a relationship with the dipole moments of the analytes. These results suggest that exposed perfluoroalkyl chains provide a distinct polar interaction environment for highly polar neutral molecules. Retention behavior of analytes other than NMP-type compounds under various mobile-phase compositions will also be discussed.

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RSC-JAIMA Symposium 2026, Makuhari Messe, Chiba, Japan, September 3-4, 2026.

Highly Sensitive Optical Detection of Bacteria Using Metal-Organic Nanohybrids

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Food poisoning and infectious disease caused by bacteria not only claim a lot of victims but also provoke serious social disruption. In order to prevent such diseases and detect their causes at an early stage, it is required to develop a simple bacterial detection and identification method which can be utilized whenever, wherever, and by whoever. Recently, nanoantenna systems based on metallic nanoparticles have been developed due to the high signal enhancement capability of biological sensors. In particular, gold nanoparticles (AuNPs), which exhibit strong light scattering properties in addition to chemical stability and biocompatibility, are expected to be used as an optical nanoantenna.

The biomedical applications of AuNPs include the use of immunogold-labeled antibodies for cell detection through microscopy and lateral flow test. In these cases, antibodies are generally introduced onto the AuNP surface via covalent bonds to establish binding sites. Detection of target cells is achieved by measuring the optical signal of AuNPs bound via antibodies. However, under a dark-field microscope, even single-grain AuNPs were observed as scattered light spots of different blue, white, and red colors depending on their dispersion state. Therefore, it was necessary to develop nanostructures with stable optical properties that were not affected by the dispersion state. In order to improve the accuracy of identification of nanostructure-labeled target cells, ideally, the scattered light should have a constant wavelength and a high intensity.

In this study, we established a reaction system in which metal nanoparticles form aggregates during the synthesis process and developed nanostructures (nanohybrids; NHs) possessing uniform light-scattering properties.^{1,2} Because they possess a nanostructure in which numerous tiny AuNPs are encapsulated within polymer particles, NHs exhibit a uniform scattered-light color under dark-field microscopy. Utilizing these hybrids as optical markers is effective for achieving high sensitivity and excellent visibility. Furthermore, since the colors exhibited by the NHs (nanohybrids) are intrinsic to their constituent metal species, optical markers displaying colors such as white (gold NH), red (silver NH), and blue (copper NH) have been developed. By functionalizing these NHs with antibodies against target bacteria to confer the ability to bind specifically to cells, it has become possible to detect multiple bacterial species simultaneously.

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An Origami Paper-Based Electrochemical Aptasensor for Neuropeptide Y Detection in Clinical Samples

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Abstract

This research presents an origami paper-based electrochemical device (o-ePAD) for the sensitive detection of neuropeptide Y (NPY) in clinical fluids. NPY is a crucial signaling peptide involved in the regulation of energy metabolism and cardiovascular function, making it a clinical relevant biomarker. However, conventional analytical techniques for NPY detection, such as HPLC and mass spectrometry, are often time-consuming, costly and require centralized laboratory facilities. Therefore, a rapid, low-cost, and sensitive platform capable of detecting NPY in clinical fluids is highly desirable for point-of-care diagnosis. Herein, we presented an o-ePAD for NPY detection. The o-ePAD was fabricated using a wax-printing and designed as a compact, portable, foldable platform that enables multiple steps within a single sheet. The device consists of four layers, including detection, sample, washing, and reaction pads, enabling sequential reagent delivery and signal generation through simple folding operations. At the sensing interface, a rationally engineered hairpin-loop aptamer was immobilized on the detection pad. The aptamer was designed to remain in a closed conformation, caging its G-rich sequences. Upon specific binding to NPY, hairpin structure open and allows the G-rich domain to form a hemin/G-quadruplex DNAzyme with peroxidase-like catalytic activity. During operation, sequential folding first delivers hemin to the aptamer-modified detection zone, followed by an integrated washing step to remove unbound substances. The reaction pad then introduces hydroquinone (HQ) and hydrogen peroxide (H₂O₂), enabling the hemin/G-quadruplex DNAzyme to catalyze the oxidation of HQ to benzoquinone (BQ). The resulting cathodic current of BQ is measured using square-wave voltammetry (SWV). Under optimal conditions, the aptasensor demonstrated high sensitivity toward NPY, with a dissociation constant (K_d) of 19.5 pM, a low detection limit of 2 pM and a linear range from 5 to 100 pM. The device also exhibited good long-term stability for approximately two months in room temperature. Successful analysis of pooled human serum and saliva further demonstrated its potential as a robust, portable solution for point-of-care NPY diagnostics.

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Cell Disruption using Surface-Modified Porous PDMS Sponges

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² Faculty of Medicine, Juntendo University

Background Cell disruption is an essential pretreatment for measuring intracellular components such as proteins and nucleic acids, metabolites, and enzymes, many of which are potential biomarkers. However, conventional disruption methods often require organic solvents or surfactants, which may induce protein denaturation. Previously, we developed a polydimethylsiloxane (PDMS) sponge with interconnected pores (~100 µm) that captures cells within its porous structure while allowing fluid to be driven through the sponge by centrifugation. In this study, we developed a porous material for cell lysis by exploiting the observation that increasing the centrifugation speed induces cell disruption. The mechanical stress generated as cells pass through the interconnected pores physically disrupts the plasma membrane without the need for chemical reagents, providing a simple and efficient reagent-free method for cell lysis.

Method PDMS sponges were surface-modified by graft polymerization of 2-aminoethyl methacrylamide (AEMA) or methacryloylcholine chloride (MCC) to yield NH₂-PDMS and QA-PDMS, respectively. NH₂-PDMS was further functionalized with poly(diallylamine-alt-maleic acid) (DAM) via ethylene glycol diglycidyl ether, producing DAM-NH₂-PDMS. Suspensions of HEK293-GFP cells were passed through the modified sponges at various centrifugation speeds, and cell membrane disruption was quantified from the change in GFP fluorescence in the filtrates before and after CuSO₄ treatment.

Result and Discussion At 10,000 rpm, the disruption rate increased with increasing cell concentration and reached approximately 70 % for DAM-NH₂-PDMS. In contrast, at lower centrifugation speeds (800 and 1100 rpm), the disruption rate remained approximately 30 %, irrespective of cell concentration. Cell capture efficiency decreased with increasing centrifugation speed, and at 10,000 rpm no substantial differences were observed among NH₂-PDMS, QA-PDMS, DAM-NH₂-PDMS, and unmodified sponges, with capture efficiencies of 30 - 60 % for all materials. Although the DAM interface forms a hydration layer that suppresses protein adsorption, no differences in disruption or capture efficiencies were observed compared with interfaces where electrostatic and/or hydrophobic interactions with the PDMS surface are expected to occur. These results suggest that cells are physically lysed by the mechanical stress imposed during passage through the porous structure. Furthermore, DAM-NH₂-PDMS is expected to reduce nonspecific adsorption of intracellular components released from disrupted cells.

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Charge-Based Classification of Extracellular Vesicle Subpopulations Using ZnO Nanowire-Integrated Microfluidic

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Abstract

Small extracellular vesicles (sEVs) are promising biomarkers that carry biomolecules reflecting the physiological and pathological states of their parent cells and play essential roles in intercellular communication. However, conventional isolation methods, including ultracentrifugation (UC) and size-exclusion chromatography (SEC), are limited by low recovery, low purity, and poor discrimination of EV subpopulations. Surface charge, which is determined by membrane composition, provides a promising basis for the selective capture and release of EVs. Cancer-derived EVs exhibit a more negative surface charge owing to altered glycosylation and increased exposure of anionic phospholipids¹, enabling charge-selective separation. Electrostatic interactions are regulated by buffer ionic strength, allowing selective EV capture and controlled release at different ionic strengths. Here, we developed a charge-based microfluidic device incorporating positively charged zinc oxide (ZnO) nanowires for the classification of EV subpopulations. The ZnO nanowires provide a high-surface-area interface for efficient electrostatic capture of negatively charged EVs², while an integrated herringbone microstructure enhances particle transport through chaotic advection. The ZnO nanowires exhibited an average height of 5.68 ± 0.60 µm and an average width of 0.26 ± 0.03 µm, corresponding to an aspect ratio of 21.5. EVs exhibited zeta potentials ranging from approximately -20 mV in ultrapure water to nearly 0 mV in 10.0x PBS, demonstrating the strong influence of buffer ionic strength on surface charge. Sequential elution using buffers of varying ionic strengths enabled the controlled release of EV subpopulations according to their surface charge. Protein immunoassays revealed correlations between EV surface charge and the expression of membrane biomarkers, including CD9, CD63, and CD81, validating the charge-based classification strategy. This ZnO nanowire-integrated microfluidic device provides an efficient approach to isolating EVs preferentially by surface charge.

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Mechanical evaluation of photo-crosslinkable phospholipid membranes at fluid interfaces and their correlation with cellular adhesion

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Abstract Cells are highly adaptive to dynamic changes in the surrounding extracellular matrices (ECMs), exhibiting their own dimensional and functional changes. Owing to its super-soft nature, an aqueous/perfluorocarbon interface decorated with photo-crosslinkable diacetylene phospholipids has emerged as an ideal platform for revealing the intrinsic adaptivity of cells, as evidenced by our discovery of cellular adaptive wetting behaviors. However, the essential mechanical properties regulating this process has remained unidentified. Here, we performed fluorescence recovery after photobleaching (FRAP) measurements and atomic force microscopy (AFM) nanoindentation with the stressed membrane model to correlate interfacial mechanical growth induced by photo-crosslinking with cellular adaptive wetting. Two different perfluorocarbons (PFC) species, FC-40 and FC-70, were employed; both measurements revealed more rapid mechanical growth at aqueous/FC-40 interface compared to aqueous/FC-70 interface. Moreover, decreased molecular mobility at highly crosslinked interfaces endowed the interfaces with gel-like nature, which facilitated robust cell adhesion. From the decoupling analysis of elasticity and interfacial prestress, we identified prestress as a primary determinant, with a significant increase following crosslinking. Furthermore, the prestress correlated well with out-of-plane deformability during cellular adaptive wetting. These analyses would advance our understanding of photochemistry at the fluid interfaces and emergent mechanics for optimal control of cell behaviors in regenerative medicines.

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Hydration Structure Measurement at the Boron-Doped Diamond Electrode-Electrolyte Interface Using Electrochemical AFM with Three-Dimensional Force Mapping.

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The electrochemical properties and interfacial behavior of BDD electrodes strongly depend on their surface termination, which can be electrochemically switched between oxygen-terminated and hydrogen-terminated states¹. Therefore, to fundamentally understand the properties of BDD electrodes, it is important to examine the electrode-electrolyte interface in detail, including the surface termination. However, the extent to which differences in surface termination affect the structure and hydration of interfacial water has not yet been fully clarified. In this study, we used electrochemical atomic force microscopy (EC-AFM), which enables nanoscale measurement of the three-dimensional force distribution at the electrode-electrolyte interface under potential control, to investigate the effect of surface termination on the interfacial hydration structure.

To investigate the hydration structure at the BDD electrode-electrolyte interface, three-dimensional frequency-shift mapping was carried out in 100 mM KCl aqueous solution. The surface termination was controlled by holding the BDD electrode at +1 V (oxygen-terminated state) and -1 V (hydrogen-terminated state) vs. Ag/AgCl. On the hydrogen-terminated BDD surface shown in Fig. 1(a), layered contrast was observed in XZ cross-sections of the three-dimensional frequency-shift map at $z_t \approx 0.3$ nm and 0.8 nm. Similarly, on the oxygen-terminated BDD surface shown in Fig. 1(b), layered contrast was observed at $z_t \approx 0.4$ nm and 0.8 nm. These features are considered to reflect hydration layers near the interface². Furthermore, the distance between the first and second hydration layers was 0.08 nm smaller on the oxygen-terminated surface than on the hydrogen-terminated surface. This difference may reflect a change in wettability associated with the surface termination.

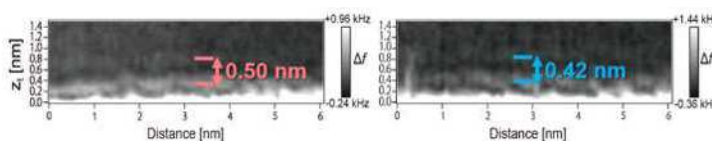


Fig. 1. XZ cross-sectional images extracted from the three-dimensional frequency shift distribution: (a) hydrogen-terminated and (b) oxygen-terminated BDD electrode surface.

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3D-Printed Hydrogels for pH-Responsive Wound Infection Theranostics

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Abstract

An innovative 3D-printed theranostic hydrogel pad based on Pluronic PF127-dimethacrylate (PF127-DMA) was developed, specifically engineered via dual-nozzle bioprinting for advanced wound management. Through optimized PF127-DMA synthesis, two dual-functional inks were formulated: a diagnostic ink incorporating bromocresol purple for real-time pH sensing and a therapeutic ink combining graphene oxide and levofloxacin for controlled drug delivery. The fabricated hydrogel demonstrated clear visual pH differentiation, distinguishing between normal skin (pH 4.0–6.0) and infected wound (pH up to 7.4) conditions. It also exhibited pH-responsive controlled release of levofloxacin, achieving cumulative concentrations of $134.34 \pm 1.46 \mu\text{g}$ at pH 7.4 and $171.68 \pm 1.59 \mu\text{g}$ at pH 8.0, with graphene oxide enhancing both drug release kinetics and intramatrix accumulation. MTT assays further confirmed the hydrogel's excellent biocompatibility with no adverse cellular effects. These findings highlight the significant potential of this theranostic platform for on-demand skin infection management, representing a promising avenue for clinical translation and industrial scalability.

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Factors Blurring Endpoint in the Redox Titration of Vanadium in Steel and Their solution

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1. Introduction Vanadium is an important alloying element that improves properties of steel. When several percent of vanadium are added to steel, impact resistance and wear resistance are improved. To determine several percent of vanadium in steel, JIS G 1221 uses a redox titration method with diphenylamine (DPA) as an indicator. This redox titration is important because it is categorized into absolute methods, in which analytical values can be obtained directly from titration results. We have found that turbidity derived from DPA occurred during the redox titration and that the color change became unclear around the equivalence point. In this study, we investigated the solution conditions to affect the redox of DPA during the titration process of JIS G 1221. We also studied to solve the problem concerning the unclear endpoint.

2. Experimental A typical titration procedure is described below. A highly pure steel sample (0.5 g) and ammonium metavanadate (0.0381 g) were dissolved with a mixed acid ($\text{H}_2\text{SO}_4:\text{H}_3\text{PO}_4:\text{H}_2\text{O} = 3:13:14$). Nitric acid was then added, and the resulting solution was heated until sulfuric acid fumes appeared. After cooling, the solution was diluted to 200 mL with water. Prior to titration, 0.05 mL phosphoric acid containing 3×10^{-6} mol DPA was added, and the mixture was titrated with 0.033 mol/L ferrous ammonium sulfate solution. During the titration, the solution potential and the a^* and b^* values (Lab color system) of the titrand were monitored.

3. Results and Discussion Figure 1 shows titration curves of V(V) under a sulfuric acid condition. Both the solution potential and the a^* and b^* values changed sharply at the equivalence point. Contrarily, when iron was coexisted in the solution, the changes in the a^* and b^* values became gradual beyond the equivalence point, as shown in Fig. 1(b). Meanwhile, the changing range of the solution potential became smaller. These results show that the iron blurs the endpoint in the redox titration. However, this effect of iron was not observed when the decomposition was performed.

To find factors responsible for the clear color change around an equivalence point, the sulfuric acid concentration was examined, first. Increasing the sulfuric acid concentration did not improve the color change. Then, the mixed acid consisted of sulfuric acid and phosphoric acid was examined instead of sulfuric acid. Sharpness of the change at the equivalence point was recovered. These results indicate that phosphoric acid plays an important role in abrupt changes in a^* and b^* values near the equivalence point.

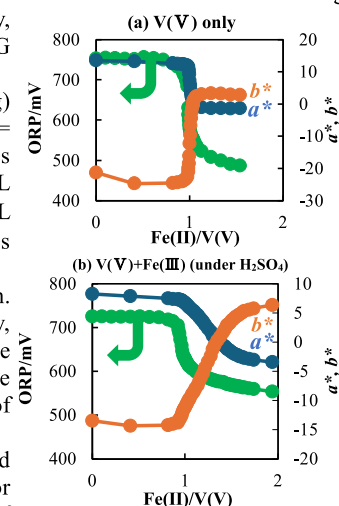


Fig. 1 Variation of solution potential and a^* , b^* values during the titration

Titrand: 3.33×10^{-2} M Fe(II).

Titrand: 200 ml. 1.6×10^{-3} M V(V)

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An Electrochemical Aptasensor for Cortisol Detection Based on DNAzyme Signal Amplification and Hairpin Aptamer Strategy

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Abstract

Cortisol, a key steroid hormone involved in mediating the body's stress response, is closely associated with stress-induced pathologies including depression and neuropsychiatric disorders, when dysregulated. Therefore, the rapid and precise quantification of cortisol holds significant importance for comprehensive health monitoring and timely clinical diagnosis. However, existing gold-standard methods, such as enzyme-linked immunosorbent assay (ELISA), remain limited by laboratory dependence, long processing time, high cost, and the requirement for skilled operators, thereby restricting their applicability in point-of-care settings. To overcome these challenges, we report an ultrasensitive electrochemical aptasensor for the rapid quantitative detection of cortisol. The sensing platform employs a screen-printed graphene electrode (SPGE) functionalized with a rationally designed hairpin DNA aptamer through a chitosan–glutaraldehyde crosslinking strategy. The aptamer incorporates a G-quadruplex-forming sequence that serves as an intrinsic electrocatalytic element. Upon target recognition and binding, the hairpin conformation undergoes structural opening, facilitating the assembly of hemin/G-quadruplex DNAzyme that mimics peroxidase activity and amplifies the electrochemical signal through the oxidation of hydroquinone (HQ) in the presence of hydrogen peroxide (H₂O₂). The resulting benzoquinone (BQ) reduction current, measured by square-wave voltammetry (SWV), is proportional to the cortisol concentration. Under optimal conditions, the aptasensor exhibited a broad linear detection range from 0.005 to 5 nM, an ultralow detection limit of 1 pM, and a total assay time of 32 minutes. Excellent selectivity toward cortisol over structurally related corticosteroids was demonstrated. The practical applicability of the proposed platform was further validated by cortisol detection in human serum and saliva, confirming its analytical accuracy and reproducibility in complex biological matrices. This study introduces a robust and miniaturized sensing platform for monitoring of stress biomarkers, offering considerable potential for integration into clinical diagnostics and point-of-care testing devices.

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Selective Dye Adsorption of Deep Eutectic Solvent-Based Cellulose Porous Materials

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Abstract Deep eutectic solvents (DESs), with properties similar to those of ionic liquids, are emerging green solvents composed of hydrogen bond donors (HBDs) and hydrogen bond acceptors (HBAs) [1]. DESs containing carboxylic acids have been widely used for extracting natural products from plants. During this process, some hydroxyl groups on the cellulose surface can be esterified into carboxyl groups, enabling the formation of carboxylated cellulose. In recent studies, DESs have shown promising results as modifiers for tuning the adsorption behavior and surface characteristics of cellulose [2]. Nevertheless, most studies focus on selectivity driven by electrostatic interactions between oppositely charged dyes, whereas selective adsorption in the same-charge systems has not been systematically investigated. This study aimed to investigate the selective adsorption behavior of cellulose porous material as an adsorbent toward cationic dye competition. The adsorbent was modified using DES system composed of citric acid as HBD and choline chloride as HBA, in various ratios. Selective adsorption behavior was evaluated in a competitive cationic dye system using methylene blue and crystal violet as model pollutants. Adsorption performance was assessed based on adsorption capacity, removal efficiency, and selectivity factor. Structural and surface characteristics of the prepared materials were systematically analyzed using FTIR, SEM, and EDX. The results revealed that increasing the HBD ratio in the DES system led to higher selective adsorption toward methylene blue, highlighting the critical role of DES composition in regulating cellulose-dye interactions. In the binary adsorption system, competitive adsorption reduced both adsorption capacity and removal efficiency relative to the single-component system due to competition for limited active sites on the adsorbent surface [3]. Further optimization is still required to enhance the selectivity toward methylene blue while maintaining high removal efficiency. These findings provide valuable insights into the relationship between cellulose structure, adsorption capacity, and selective adsorption behavior in DES-modified cellulose systems.

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Integrated Lateral Flow Strip for On-Device CRISPR/Cas12a-Based Colorimetric Nucleic Acid Detection

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Background Nucleic acid detection is generally performed by PCR, but this method requires long assay times and complex operational procedures. Recently, the CRISPR/Cas12a system has been applied to simplified nucleic acid detection platforms due to its high specificity and mild reaction conditions. CRISPR/Cas12a specifically recognizes target DNA (tgDNA) and cleaves surrounding single-stranded DNA (ssDNA), making it suitable as a signal transducer. For signal visualization, we have previously developed a colorimetric detection method using ALP-labeled ssDNA [1]. However, this method requires multiple complex operations and a large amount of reagents. By applying the reaction products of CRISPR/Cas12a to a lateral flow strip, faster and simpler nucleic acid detection has been achieved [2]. However, no on-device assay has been reported that can complete the entire process from the CRISPR/Cas12a reaction to detection on the strip.

Concept Our aim is to develop an on-device assay for highly sensitive, simple, and rapid tgDNA detection by integrating CRISPR/Cas12a and ALP on a lateral flow strip. All reagents are pre-deposited onto the strip, and tgDNA can be detected by observing a color change when a sample solution is added (Fig. 1). Only in presence of tgDNA in the sample, the ssDNA part of the ALP probe is cleaved by activated CRISPR/Cas12a, releasing the ALP and producing a colorimetric signal.

Results The ALP probe was successfully synthesized and a tgDNA concentration-dependent response was obtained in solution system when only tgDNA was added to the synthesized ALP probe and CRISPR/Cas12a. Using a strip pre-deposited with these necessary reagents, the addition of tgDNA resulted in a color change in response to tgDNA, suggesting that detection is possible by visual inspection.

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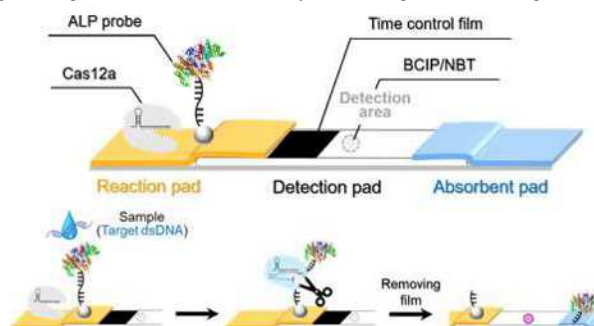


Fig. 1 Concept image of this work

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Portable On-Site Detection of Paraquat Using a Carbon Nanotube/Cobalt-MOF Electrochemical Sensor

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Abstract Paraquat (PQ) is a highly toxic herbicide that can cause multiple organ failures and death upon exposure. Recently, rising PQ levels in aquatic environments worldwide have heightened concern. As a result, rapid on-site detection of PQ is essential and can be achieved through electrochemical sensing. This research aims to develop a portable, selective, and sensitive electrochemical sensor by modifying a screen-printed carbon electrode (SPCE) with carbon nanotubes (CNTs) and a cobalt metal-organic framework (Co-MOF). The CNT/Co-MOF composite was characterized using scanning electron microscopy, X-ray diffraction, and electrochemical techniques. The analytical performance, including linearity, detection limit, and recovery, was comprehensively assessed. The synthesized CNT/Co-MOF/SPCE demonstrates improved electrocatalytic activity, as evidenced by the sensor's low resistance of 14.91 Ω . The high electrochemical surface area of 0.732 cm^2 enhances electron transport and sensitivity. A pair of redox for PQ were observed at -0.85 V and -0.7 V in 0.1 M phosphate buffer at pH 8. The linear relationship between peak current and the square root of the scan rate indicates a diffusion-controlled, quasi-reversible redox process. The PQ redox signal increases with pH due to diminished interference from hydrogen ions; pH 8 was selected for subsequent experiments to mitigate PQ hydrolysis under alkaline conditions. A linear response was observed over the concentration range of 5 μM to 10 mM, with a detection limit of 1.29 μM . The CNT/Co-MOF/SPCE enhances and stabilizes PQ detection across a broad concentration range and achieves high sensitivity at trace levels, making it suitable for PQ monitoring in environmental settings without complex instrumentation. This advancement supports the development of portable sensor technologies, particularly in resource-constrained environments.

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Electrochemical Immunosensor for Non-Invasive Salivary TNF- α Detection.

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Abstract

This study presents a label-free electrochemical immunosensor for non-invasive detection of tumor necrosis factor- α (TNF- α) in human saliva. The sensor is based on a hierarchical nanocomposite of hemp-derived nanocellulose (HNC), polyvinyl alcohol (PVA), PEDOT:PSS, and electrodeposited gold nanoparticles (AuNPs). The porous HNC structure enables efficient antibody immobilization, while the conductive matrix enhances electron transfer. Under optimized conditions, the immunosensor showed a linear detection range of 5–300 pg mL⁻¹, a low detection limit of 3.91 pg mL⁻¹, and high selectivity against common interferents. Clinical saliva sample analysis showed strong agreement with standard ELISA, highlighting its potential for point-of-care inflammatory biomarker monitoring.

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Development and Electromechanical Characterization of PPyDBS-based Flexible Actuators for Enhanced Neural Interfaces

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Abstract

Soft actuators are promising for advanced neural interfaces due to their flexibility, biocompatibility, and ability to conform to delicate tissues, mitigating the mechanical mismatch and signal degradation typical of traditional rigid microelectrodes. This study presents a highly controllable, self-bending PPy/DBS soft actuator designed to minimize surgical risks and enhance neural modulation. The device was fabricated via potentiostatic electropolymerization of pyrrole and NaDBS onto an Au-coated polyimide substrate. Scanning Electron Microscopy (SEM) analyses revealed that a 1 mA deposition current yielded optimal surface morphology and macroscopic bending. Actuation is fundamentally driven by the reversible influx and efflux of sodium ions (Na⁺). Cyclic voltammetry (CV) and charge-discharge tests demonstrated precisely programmable bending, with the curling effect progressively enhanced by applying increasing oxidation voltages up to 1.2 V. Energy Dispersive X-Ray Spectroscopy (EDS) and Electrochemical Impedance Spectroscopy (EIS) corroborated this mechanism, showing distinct correlations between sodium concentration and impedance changes. The actuator exhibited outstanding durability, maintaining a high charge storage capacity of 181.66 mC/cm² after 100 CV cycles. Finally, successful integration with a PDA-IrOx hybrid microelectrode array on Parylene C demonstrated excellent flexibility and stable electrochemical functionality, highlighting its potential for adaptive neural interfaces.

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Optimal column selection for measurement of Experimental Polar Surface Area using supercritical fluid chromatography

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Lipophilicity is an important molecular property in drug development because it strongly influences oral bioavailability and membrane permeability. Polar surface area (PSA) is a physical property indicating the polar exposure on the molecular surface and widely used as an indicator of membrane permeability, and compounds with a PSA greater than approximately 140 Å² are generally considered to exhibit poor membrane permeability¹. Although topological PSA (TPSA) can be easily calculated from molecular bonding patterns, it often overestimates the actual polar exposure of middle molecules such as peptides because it does not account for three-dimensional molecular behavior. To overcome this limitation, experimental PSA (EPSA), determined from retention times in supercritical fluid chromatography (SFC), has been recently paid attention as a more reliable predictor of membrane permeability². However, the existing EPSA method employs an expensive chiral stationary phase containing (*S*)-valine and (*R*)-1-(α -naphthyl) ethylamine, and interactions between the stationary phase and phenyl groups in analytes may interfere with the appropriate EPSA calculation. In this study, the feasibility of calculating EPSA using SFC columns with different stationary phases was investigated. Column screening was performed using nine compounds with known EPSA values and thirteen columns containing different stationary phases. Columns showing strong correlations between retention time and EPSA were selected for further evaluation. Small molecules and peptides were then analyzed using the selected columns, and the obtained EPSA values were compared with those generated by the existing method. In addition, the peptide drugs cyclosporine A (not included in the performance comparison) and ritonavir were evaluated.

Among the tested stationary phases, four columns showed relatively strong correlations between retention time and PSA. In particular, triazole-containing stationary phase showed good accordance with EPSA values obtained by the conventional method. For peptide drugs, the calculated EPSA values were significantly lower than the corresponding TPSA values, supporting the idea that TPSA overestimates the actual PSA of middle molecules. The use of multiple columns to calculate EPSA not only improved the reliability of the obtained values but also increased the versatility of the analytical method. Furthermore, this approach may enable more accurate EPSA estimation for compounds that cannot be properly evaluated using the stationary phases employed in the existing method.

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Raman Band Selection for Starch Determination During Postharvest Ripening of Banana

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Background

Starch content governs the taste and texture of bananas during postharvest ripening. Raman spectroscopy, a light-based technique largely unaffected by moisture, offers a promising non-destructive, rapid alternative to enzymatic analysis for banana quality control. This study aimed to build a prediction model for starch content in Cavendish bananas from Raman spectra and to identify wavenumber bands that reflect only starch information.

Methods

Thirty-six Raman spectra were collected from banana pulp over one week of ripening, and reference starch values were obtained by enzymatic analysis. Spectra of pure starch, sugars, and dietary fibers were acquired to verify spectral assignments, revealing that sugar signals and fiber-derived noise can interfere with starch information as ripening progresses. Along with 10 other variable selection strategies, the novel Causal Analysis via Kernel Estimation (CAKE) was applied to distinguish wavenumber bands driven solely by starch from those that overlap with other components.

Results

Starch decreased from 66.84% to 4.58% over one week. CAKE identified two bands at 468 and 930 cm⁻¹, assigned to the glycosidic linkage and the starch polymer backbone. These bands were confirmed to be free of sugar interference by pure-substance spectral analysis and were consistently observed throughout ripening, during which starch degradation and amorphization occur. The PLS prediction model based on these two bands achieved a 15.44% lower prediction error than other variable selection methods, demonstrating that causality-driven feature selection improves both accuracy and chemical interpretability for starch determination in bananas.

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Comparative Characterization of Green-Synthesized TiO₂ Nanoparticles Using Aqueous and Ethanolic Extracts of Passiflora edulis Peel and Preliminary Evaluation of Their Photocatalytic Activity Against Sulfamethoxazole

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Abstract

Introduction Sulfamethoxazole (SMX), a persistent sulfonamide antibiotic, is a recalcitrant aquatic contaminant that resists conventional wastewater treatment and contributes to antimicrobial resistance [1]. TiO₂-based photocatalytic advanced oxidation offers an effective remediation route. Green synthesis via plant extracts is a sustainable and low-hazard alternative to conventional methods; yet the role of extraction solvent polarity on TiO₂ properties remains underexplored, especially using tropical bioresources such as Passiflora edulis peel.

Aim This study comparatively synthesizes and characterizes TiO₂ nanoparticles mediated by aqueous (EA) and ethanolic (EE) extracts of P. edulis peel, and provides a preliminary evaluation of their photocatalytic activity against SMX.

Methodology TiO₂ nanoparticles were prepared via sol-gel using titanium(IV) isopropoxide (TTIP), mediated by EA and EE extracts of dried P. edulis peel. Both samples were characterized by XRD, FTIR, UV-DRS (Tauc plot), and FESEM-EDS. Photocatalytic activity was evaluated against 25 mg/L SMX under UV-C ($\lambda = 254$ nm) and monitored spectrophotometrically at 257 nm.

Results Both samples exhibited the anatase phase by XRD. Key characterization results are shown in Table 1. Notably, TiO₂-EA showed primary crystallites four times smaller than TiO₂-EE (10.4 vs. 41.8 nm), indicating stronger crystal growth inhibition by polar phytochemicals [2]. UV-DRS Tauc plots revealed meaningful bandgap narrowing only in TiO₂-EA (3.28 vs. 3.37 eV). FTIR confirmed phytochemical surface capping in both samples. In preliminary photocatalytic tests, TiO₂-EA outperformed TiO₂-EE and UV-only controls in SMX removal, consistent with its smaller crystallite size and larger accessible surface area.

Conclusion Aqueous extraction of P. edulis peel produced TiO₂ nanoparticles with markedly superior properties: four-times-smaller primary crystallites, a lower bandgap (3.28 vs. 3.37 eV), and stronger preliminary photocatalytic activity against SMX [3]. Extraction solvent polarity is thus a critical determinant of biogenic TiO₂ performance, with broader implications for sustainable photocatalyst design in antibiotic wastewater remediation.

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Improved spatial resolution using phase recovery methods in pattern illumination time-resolved phase microscopy (PI-PM)

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[Introduction] Time-resolved methods such as transient absorption and photoluminescence spectroscopy reveal charge-carrier dynamics but give spatially averaged information, masking local heterogeneity in photocatalysts. Our home-built Pattern-Illumination Time-resolved Phase Microscopy (PI-PM) resolves carrier dynamics with electron/hole distinction by pixel-by-pixel clustering.¹ However, the defocusing needed for phase contrast lowers the spatial resolution.² Here we apply phase retrieval to recover the in-focus phase without sacrificing resolution.

[Experimental] A striped light pattern generates photo-excited carriers, and the refractive-index change is imaged by phase contrast imaging technique. The in-focus phase is recovered by combining the Transport of Intensity Equation (TIE), which gives an initial estimate from two symmetric defocused images. Furthermore, with the Gerchberg-Saxton (GS) algorithm, the phase was refined over 300 iterations under experimentally measured amplitude constraints. A BiVO₄ thin film was used as a sample.³

[Results and Discussion] Figure 1 compares the conventional defocused phase image with the TIE and GS reconstructions. The conventional image is rounded and blurred by the limited resolution. (Figure 1B) Although TIE improves the image, fine structural details remain indistinct, whereas GS sharpens the boundaries and resolves small surface structures, giving a clear gain in spatial resolution and providing high-resolution phase images for subsequent clustering analysis of local carrier dynamics.

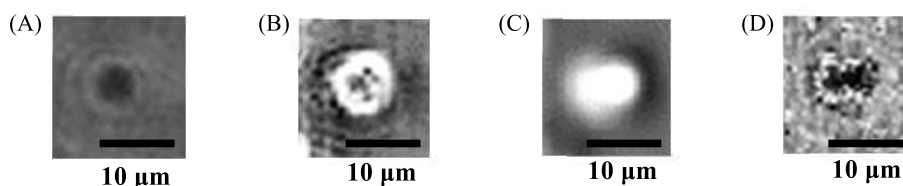


Figure 1. (A) Microscopic image; (B) phase image by the defocusing; phase reconstruction results are shown in (C) TIE method and (D) GS method.

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RSC-JAIMA Symposium 2026, MakuHari Messe, Chiba, Japan, September 3-4, 2026.

Green Synthesis of TiO₂ Nanoparticles using *Archidendron pauciflorum* (Jengkol) Peel Extract for Photocatalytic Degradation of Paracetamol Wastewater

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Abstract This study investigates Jengkol (*Archidendron pauciflorum*) peel waste as an extract for a bio-stabilizing and reducing agent in the sol-gel synthesis of TiO₂ nanoparticles (TiO₂ NPs) is an economical and environmentally friendly technique. Different calcination temperatures (500 and 550°C) were used to examine their effect on the properties and the photoactivity of TiO₂. Multiple characterization methods were employed to assess the different features of the prepared materials. The findings demonstrated that higher calcination temperatures resulted in lower macrostrain, dislocation density, and unit cell volume and an increase in crystallite size. Monitoring the efficiency of paracetamol (PCT) degradation with TiO₂-A NPs calcined at 500°C with a 16.60 nm crystalline size gave an efficiency of 99.0%, while 99.9% for TiO₂-B with 20.22 nm at 550 °C. The low crystallite size and high purity of the anatase phase, which favour photocatalytic activity, are found to be the causes for the low efficiencies of degradation for the TiO₂ NPs. Efficient synthesis of photocatalyst material from jengkol waste peel is indicated in this study, hence giving support to green chemistry and sustainability in waste management.

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RSC-JAIMA Symposium 2026, Makuhari Messe, Chiba, Japan, September 3-4, 2026.

A Self-Reporting Electrochromic Aptasensor for Label-Free Salivary Cortisol Detection Using a Smartphone-Readable Polyaniline Interface

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Salivary cortisol is an important biomarker for non-invasive evaluation of stress status and clinical conditions related to hypothalamic–pituitary–adrenal axis activity. However, conventional analytical methods, including ELISA and HPLC, generally require labeled reagents, multistep protocols, and laboratory-based instrumentation, limiting their suitability for decentralized testing. Herein, we report a label-free electrochromic aptasensing platform for cortisol detection based on a bifunctional polyaniline (PANI) interface. PANI was electropolymerized in its leucomeraldine state, corresponding to the yellow form, onto an indium tin oxide screen-printed electrode. The resulting PANI layer simultaneously functioned as an aptamer immobilization matrix and an intrinsic electrochromic transducer, thereby removing the need for additional redox mediators or signal labels. Upon specific recognition of cortisol by the surface-bound aptamer, the interfacial resistance of the working electrode increased, leading to a visible electrochromic response. This color change was recorded using a smartphone camera and converted into quantitative analytical signals through RGB-based image analysis. The proposed “lab-to-pocket” strategy enables visual and instrument-free signal generation while maintaining quantitative detection capability. Under optimized conditions, the aptasensor exhibited a linear response to cortisol over the concentration range of 1–100 nM, with a limit of detection of 0.35 nM. The sensor also demonstrated good selectivity against structurally related corticosteroids and was successfully applied to cortisol detection in saliva samples. Owing to its simplified architecture, label-free operation, smartphone readability, and practical sample applicability, the developed electrochromic aptasensor provides a promising platform for point-of-care cortisol monitoring and personalized stress-related healthcare.

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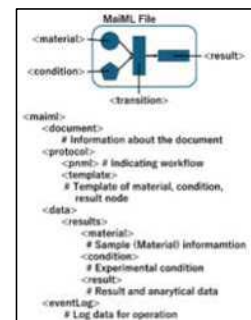
MaiML: A Common Data Format for Measurement and Analysis and Its Application to an Autonomous Experimental System

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AI-driven materials research depends on interoperable, machine-readable data. Instrument- and vendor-specific formats often separate measurement values from sample history, experimental conditions, workflows, and analysis provenance, limiting dataset aggregation, reproducibility, and closed-loop automation. MaiML (Measurement, Analysis, Instrument Markup Language) was developed as a common format for measurement and analysis data [1]. Its requirements are specified in JIS K 0200:2024 [2]; international standardization and a VAMAS round-robin exercise are in progress. Unlike device-centric files, MaiML represents the experimental context required for interpretation and reuse, providing a vendor-neutral interface among instruments, laboratory systems, analysis software, and AI or optimization services.

MaiML uses an extensible XML hierarchy to describe document metadata, protocols, sample and material information, measurement conditions, results, analytical data, and event logs. A Petri-net representation records transitions and relationships among workflow elements, so the same information model supports both data exchange and execution traceability. Its central principle, "Independent Availability," requires a MaiML file to retain the information needed to understand and use the data without access to the originating instrument or proprietary software. Namespaces and ontologies standardize terminology while allowing technique- and vendor-specific extensions. These features improve integrity, provenance, interoperability, and reuse across heterogeneous platforms, and enable aggregation of trustworthy datasets for materials informatics. The proof-of-concept system has already been established in the Univ. of Tokyo [3].



MaiML functions as a common information model between experimental execution and AI-driven decision making. By preserving workflow context and provenance together with data, it supports reproducible, interoperable, and AI-ready autonomous experimentation. Continued ISO standardization, interoperability testing, and implementation feedback will be important for broader adoption.

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RSC-JAIMA Symposium 2026, Makuhari Messe, Chiba, Japan, September 3–4, 2026.

Surface-Confined Molecular Imprinting on an Extended-Gate Organic Field-Effect Transistor for Oxytocin Sensing in Human Saliva

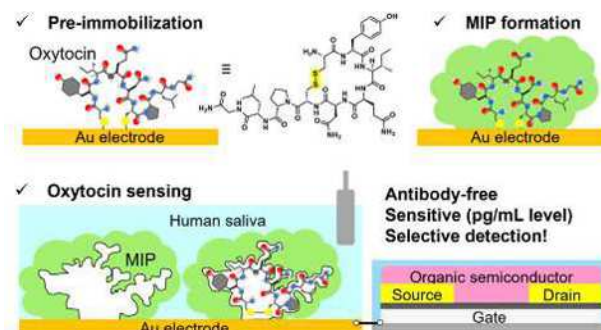
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Abstract Oxytocin sensing in human saliva remains challenging because of its ultra-low physiological concentrations and the complexity of the salivary matrix.^[1] Herein, we report surface-confined molecular imprinting on an extended-gate-type organic field-effect transistor (OFET) for oxytocin sensing in human saliva. Oxytocin template molecules were preimmobilized on an Au extended-gate electrode before electrochemical polymerization of dopamine as a functional monomer, thereby enabling the formation of molecular recognition cavities at the electrode/electrolyte interface. Density functional theory calculations supported the presence of non-covalent interactions between dopamine and oxytocin during the preorganization process. The resulting molecularly imprinted polymer-functionalized extended-gate electrode showed selective interfacial recognition of oxytocin in differential pulse voltammetry over the 0–15 ng mL⁻¹ range. When coupled with the OFET device, the sensor exhibited a dynamic response to oxytocin over the range of 0–50 pg mL⁻¹ with a limit of detection of 0.51 pg mL⁻¹. The applicability of the sensor for salivary analysis was evaluated using spike-and-recovery tests in minimally pretreated, undiluted human saliva, affording recovery rates of 92.5–95.8% at 2–6 pg mL⁻¹. These results demonstrate that surface-confined molecular imprinting on an extended-gate OFET provides a promising platform for oxytocin sensing in complex biological media.^[2]



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Relationship between mineral phases in steelmaking slag and leaching behavior of constituent elements under strongly acidic conditions

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1. Introduction Steelmaking slags are a byproduct generated during the steelmaking process and have been widely reused as road base material, ground improvement material, and cement raw material. The steelmaking slags contain various elements such as Al, Ca, Fe, Mg, Mn, S, and Si, originated from their raw materials. It is important to monitor their contents of the elements and to elucidate their leaching characteristics when the slags are utilized again. Among these elements we have studied leaching behavior of Mn. With the aim of gaining more insights that enable to utilize the steelmaking slags as more valuable materials, this study investigated the leaching behavior of the major elements leached from steelmaking slags and discussed their relationship to the mineral phases and the basicity.

2. Experiment Six kinds of steelmaking slags (four converter slags and two electric arc furnace slags) were examined. 2 g of the slag sample and 20 mL of an acidic solution were added to a centrifugal tube. The resulting mixture was shaken horizontally for 6 hours and centrifuged. After the supernatant was filtered with a membrane filter cartridge (pore size 0.45 μm), the filtrate was subjected to ICP-AES measurement. Meanwhile, the crystal structures and contents of the slags separated as a precipitate were measured with XRD and XRF, respectively.

3. Result and Discussion First, the relationships between acid concentrations and concentrations of elements eluted from steelmaking slags were examined using hydrochloric acid. The acid concentration gave a significant effect on the elements' leaching. The leaching concentrations of all elements except Si increased with increasing the acid concentration. Among these elements, Fe, Mg, Mn begins to elute at a certain concentration of hydrogen ion.

Second, to elucidate the leaching behavior more precisely, the leaching of elements from the steelmaking slags during repeated acid treatments were performed. Figure 1 shows the typical results of obtained with the converter slag. The concentrations of Al, Fe, Mg, Mn, and Si reveal maximum value at the second treatment. This behavior could be explained with the basicity (CaO/SiO₂ mass ratio) of the slags. The basic components in slags neutralized the added acids to maintain pH of the supernatant, causing less leaching elements. Specifically, the pH of the supernatant after the first treatment was 5.772, whereas it decreased to 1.99 after the second treatment.

Finally, XRD measurements were performed to elucidate changes in the contents of mineral phases in the slags. After the acidic treatment, olivine phase vanished whereas spinel phase remained.

Based on the above results, we consider that the leaching behavior of elements in steelmaking slag is strongly influenced by its basicity and mineral phases. These findings are expected to contribute to the development of versatile and valuable materials from steelmaking slag as a raw material.

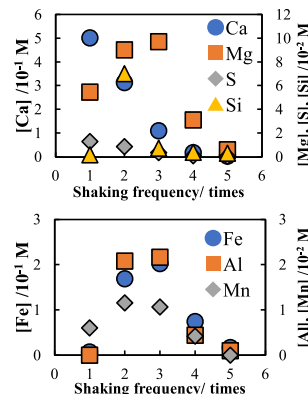


Figure 1. Concentration of eluted elements from converter slag during repeated acid treatments
[HCl]: 1.0 M, Solid-liquid ratio: 1 g / 10 mL, shaking time: 6 hr, centrifuge: 4100 rpm 20 min

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Surface Engineering of Exfoliated CoFe-LDH Nanosheets via Polydopamine-Anchored Ir³⁺ for Stable Seawater Oxidation

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Green hydrogen production via water electrolysis is a promising route to reduce reliance on fossil fuels. However, the sluggish kinetics of the oxygen evolution reaction (OER) and the degradation of catalyst stability at high current densities—particularly in complex environments such as alkaline seawater—remain major obstacles to practical application. Developing a catalyst that combines high activity with long-term durability is therefore essential. CoFe layered double hydroxides (LDHs) are attractive OER catalysts because their layered host structure offers a readily tunable metal composition, abundant redox-active sites, and, crucially, the ability to be exfoliated into ultrathin nanosheets that expose a high density of coordinatively unsaturated active centers. Building on these advantages, CoFe-LDH was exfoliated into nanosheets (CoFe-NS) and then modified with a polydopamine (PDA) layer that served as a uniform platform for anchoring various metal ions, simultaneously improving the dispersion of the incorporated species and reinforcing the structural stability of the nanosheets. Among the metal ions examined, Ir³⁺ incorporation delivered the highest OER activity, requiring an overpotential of only 296 mV to reach a current density of 100 mA cm⁻². Moreover, the resulting CoFe-NS@PDA(Ir) catalyst operated stably for over 200 h at 500 mA cm⁻² in 1 M KOH containing natural seawater. This work thus presents an effective surface-engineering strategy that leverages the intrinsic merits of the exfoliated LDH phase to overcome the durability challenges of practical alkaline seawater electrolysis.

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Microstructural Analysis of Cellular Tunneling Nanotubes via Electrochemical Approaches

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Animal cells constantly interact with other cells and their surrounding environment through the exchange of materials. Among the various modes of intercellular communication, tunneling nanotubes (TNTs) are tubular structures, which allow the direct transfer of ions, proteins, organelles, and other cellular contents between distant cells. While TNTs hold potential for novel therapeutic strategies, such as delivering drugs to distant cells, they are also implicated in the spread of pathogens like viruses and the progression of diseases [1]. Therefore, elucidating their morphology is medically crucial. However, the delicate nature of TNTs limits the use of conventional microscopy for non-invasive, high-resolution 3D imaging. To overcome this challenge, our laboratory is investigating TNT morphology using scanning ion conductance microscopy (SICM), which enables such advanced observation. Furthermore, we are attempting multifaceted TNT imaging using electrochemiluminescence (ECL), a method that allows for the simple visualization of cell adhesion. In this report, we performed imaging of the identical TNT using both techniques and investigated a method for sequential observation within the same field of view.

High-purity human mesenchymal stromal cells (passage 4, PuREC, Shimane, Japan) were seeded onto matrigel-coated indium tin oxide (ITO) electrodes and cultured for 24 hours. The cells were then fixed, and the topography of the TNTs formed during the culture process was imaged using SICM. An ECL solution containing 1 mM [Ru(bpy)₃]Cl₂ and 10 mM tripropylamine in PBS was prepared. Using a three-electrode system consisting of an ITO working electrode, an Ag/AgCl (sat. KCl) reference electrode, and a Pt counter electrode, the potential was stepped from 0 V to 1.3 V and applied for 10 seconds to acquire ECL images.

In this study, we have successfully observed a TNT located within the same 100 × 100 μm region for the first time by utilizing these two distinct techniques. Specifically, we achieved a sequence of measurements—SICM, followed by ECL, and then SICM again—within the same field of view. These results demonstrate that correlative imaging using both techniques is feasible without destroying the delicate TNT structures.

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RSC-JAIMA Symposium 2026, Makuohari Messe, Chiba, Japan, September 3-4, 2026.

Mechanochemical Behavior of Polytetrafluoroethylene Co-milled with Inorganic Salts

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Introduction Polytetrafluoroethylene (PTFE) possesses high chemical and thermal stability owing to its strong C-F bonds and highly crystalline structure¹. However, these characteristics also make PTFE difficult to process and recycle. We previously demonstrated that co-milling PTFE with NaCl induces changes in its crystalline structure and morphology, while the added salt can subsequently be removed by washing^{2,3}. In the present study, PTFE was co-milled with different inorganic salts to clarify how the salt species affect the structural and surface properties of the recovered PTFE.

Experimental PTFE was co-milled with selected inorganic salts under identical conditions. After washing and drying, the recovered PTFE was characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM), and nitrogen adsorption-desorption measurements. The analytical results were compared with a calculated dipole-moment descriptor of each salt.

Results and discussion The crystalline structure, morphology, and nitrogen adsorption properties of PTFE depended on the salt used. SEM images showed that NaBr-treated PTFE had a highly textured surface with many void-like features, whereas NaF-treated PTFE exhibited a relatively compact and fibrillar morphology (Fig. 1). These differences were consistent with the BET specific surface areas and adsorption behavior. For monovalent salts, the extent of PTFE modification showed a systematic relationship with the calculated dipole-moment descriptor, suggesting that the electrostatic properties of the salts affect the mechanochemical interaction with PTFE.

Outlook In the presentation, we will discuss the relationships among the properties of the inorganic salts, the structural changes in PTFE, and the nitrogen adsorption characteristics based on the combined XRD, SEM, and adsorption results.

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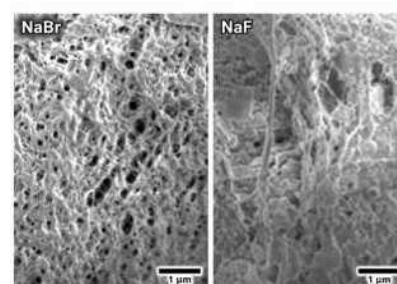


Figure 1. SEM images of washed PTFE co-milled with NaBr (left) and NaF (right). Scale bars: 1 μm.

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The Preparation and Characterization of a ADP Sensor Based on Dipicolylamine-Copper(II)/Phenylboronic-acid Modified Cyclodextrin Inclusion Complex

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Abstract We designed a supramolecular complex consisting of a dipicolylamine copper complex with an azobenzene group and phenylboronic acid-modified cyclodextrin for adenosine 5'-diphosphate (ADP) recognition in water. Evaluating its phosphate recognition ability through UV-vis and induced circular dichroism (ICD) spectroscopy demonstrated high selectivity and a large binding constant for ADP in water [1].

In UV-Vis spectra, with equivalent addition of phosphate derivatives to the complex **1·Cu/FPB-βCyD**, a selective short-wavelength shift was observed for ADP. The binding constant was calculated as $4.28 \times 10^4 \text{ M}^{-1}$ and was ADP-specific. This is considered to be due to the optimal distance between dpa moiety and phenylboronic acid within the sensor relative to the size of ADP, with various interactions working synergistically. From ICD spectrum measurements in **1·Cu/FPB-βCyD**, a positive Cotton effect around 360 nm and a negative Cotton effect around 450 nm were observed when phosphate containing an adenosine moiety was added. These effects suggest that the azo group adjacent to CyD was encapsulated within CyD due to its binding with phosphates. This was also supported by 2D-NMR measurements.

These investigations into the recognition mechanism suggested that the high sensitivity is due to the formation of a supramolecular complex through a combination of four weak interactions: 1) coordination binding of phosphoric acid by dpa-copper complexes; 2) interaction between the *cis*-diol moiety of the adenosine ribose unit and phenylboronic acid; 3) stacking interaction between the modified phenyl group and adenosine; and 4) inclusion of the probe into CyD (Fig 1). These results give rise to an interesting method of molecular recognition based on supramolecular formation through a combination of weak interactions and provide fundamental data on the recognition of phosphate derivatives *in vivo* or in real samples.

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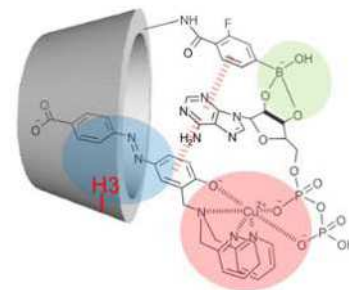


Fig. 1 Structural image of ADP recognition for **1·Cu/FPB-βCyD**.

RSC-JAIMA Symposium 2026, Makuhari Messe, Chiba, Japan, September 3-4, 2026.

Seeing Alumina Coating in a New Light: SEM-Raman-CL Synergy

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²RENISHAW K.K.

Abstract Alumina thermal-sprayed coatings are widely used in industrial applications due to their excellent wear resistance, heat resistance, and electrical insulation properties. During the thermal spray process, rapid heating and cooling lead to the formation of both the stable α - Al_2O_3 phase and the metastable γ - Al_2O_3 phase [1]. Since the distribution of these phases and the resulting microstructure strongly influence coating properties, comprehensive understanding is essential.

In this study, a Raman spectrometer (Renishaw plc.) was integrated into the chamber of a scanning electron microscope (SEM), enabling both SEM observation and Raman analysis to be performed in the same region. Figures 1a and 1b show backscattered electron (BSE) and low-vacuum hybrid secondary electron-photon detector (LHSE-PD) images of the alumina coating, respectively. The LHSE detector, installed in the SEM, captures signals originating from cathodoluminescence (CL), allowing visualization of differences between individual particles. Figure 1c presents the Raman spectrum of the central particle, showing it as α - Al_2O_3 . Recently, CL capability was added to the Raman spectrometer, enabling sequential acquisition of Raman and CL spectra within the same instrument. This combined approach is expected to improve understanding of the relationship between microstructure and coating properties.

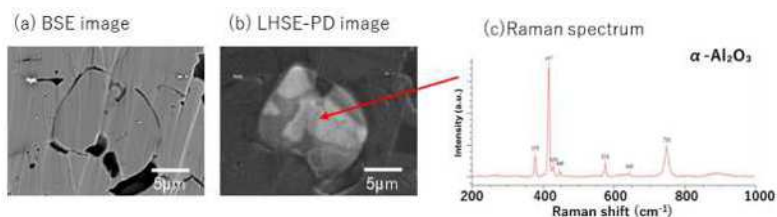


Fig. 1. (a) BSE image of alumina coating, (b) LHSE-PD image of the same region, (c) Raman spectrum of central particle (red arrow in (b)).

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RSC-JAIMA Symposium 2026, Makuhari Messe, Chiba, Japan, September 3-4, 2026.

A Bioluminescence-Based Chemical Screening Method Using Printed Paper Microplate

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Background Serum albumin is the most abundant protein in blood, and evaluating binding affinity of chemicals including drug candidates to serum albumin is important in pharmacology. Albumin has been reported to exhibit bioluminescence (BL) as a pseudo-luciferase [1], allowing its binding interactions to be evaluated through BL. However, conventional microplate-based assays consume large amounts of reagents and time. We developed an efficient BL imaging system for detecting chemicals that bind to serum albumin by combining paper microplates, which require only small amounts of reagents, with an inkjet printer that enables uniform and automated reagent dispensing onto multiple spots.

Experiment We developed a paper-based imaging system using human serum albumin (HSA) and TS2, a coelenterazine-based substrate that emits light specifically in the presence of HSA. The presence of HSA-binding chemicals was evaluated based on the decrease in BL intensity caused by their competitive inhibition to the HSA–TS2 system (Fig. 1). The paper microplate was designed to mimic a 96-well plate, with reaction spots formed using hydrophobic wax. TS2 was dispensed onto multiple spots by inkjet printing, enabling simultaneous reactions.

Result Warfarin, used as a model HSA-binding compound, caused a concentration-dependent decrease in BL intensity on the paper microplate, demonstrating that HSA-binding compounds can be detected. The developed method reduced reagent consumption from 50 μ L to 5 μ L per measurement and shortened the measurement time to several minutes, while enabling the simultaneous analysis of multiple samples.

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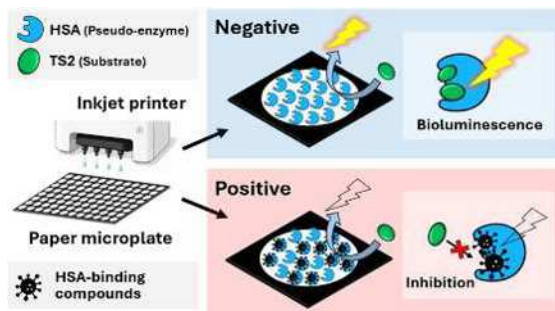


Fig. 1 Reaction mechanism using paper and printer

RSC-JAIMA Symposium 2026, MakuHari Messe, Chiba, Japan, September 3-4, 2026.

Fabrication of cyclic peptide-immobilized Au screen-printed electrodes for cell sensing

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Cancer remains one of the leading causes of mortality worldwide, and its early detection and treatment are essential for improving patient outcomes. In recent years, blood-based diagnostic techniques have attracted considerable attention as minimally invasive approaches with low physical and psychological burden for cancer screening [1]. One such strategy is an electrochemical cell sensing method that uses electrodes immobilized with probes capable of both cell recognition and signal transduction. Screen-printed electrodes (SPEs) offer a platform for cancer screening because of their ease of surface modification and simple handling [2]. Here, an electrochemical sensing system for the detection of target cells was developed based on a cyclic peptide probe incorporating an electron-transfer peptide into a target cell-recognition peptide.

A human monocytic leukemia cell line (THP-1 cell) was selected as a model cell. The cell-recognition sequence was based on the THP-1-binding peptide KQKWIQ. An electron-transfer peptide containing cysteine, tyrosine, and tryptophan residues was incorporated into the cyclic peptide probe. The cyclic peptide was immobilized onto a gold screen-printed electrode (AuSPE) surface via disulfide bonds using a self-assembled monolayer strategy. Electrochemical measurements were performed using the peptide-modified AuSPE in an electrochemical cell following the addition of THP-1 cells.

Oxidation peaks derived from the electron-transfer peptide moiety were observed at approximately +0.70 V (vs. Ag) using the AuSPE modified with the cyclic peptide. Upon incubation of THP-1 cells with the cyclic peptide-modified AuSPE, the oxidation peak current decreased in a concentration-dependent manner as the THP-1 cell concentration increased. This decrease is attributed to the interaction between the cell-recognition peptide and membrane proteins on the cell surface, which inhibited electron transfer to the electrode. The calibration curve constructed from the electrochemical responses exhibited excellent linearity over the range of 5–500 cells mL^{-1} , with a limit of detection of 2 cells mL^{-1} . These results demonstrate that the proposed electrochemical sensing system represents a promising new strategy for highly sensitive cell sensing.

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RSC-JAIMA Symposium 2026, MakuHari Messe, Chiba, Japan, September 3-4, 2026.

A Mass Spectrometry-Based Method for the Analysis of Short Chain Hydroxy Acids in Small Volume Samples

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Abstract Lactic acid and β -hydroxybutyric acid are important hydroxy acid metabolites involved in human energy metabolism. Elevated concentrations of these compounds are closely associated with metabolic acidosis and related disorders, making them valuable biomarkers for disease assessment and monitoring. However, their analysis remains challenging because they lack conjugated double bonds and aromatic structures, preventing direct detection by ultraviolet or fluorescence detectors. Furthermore, their low ionization efficiency limits sensitive mass spectrometric detection, particularly at low concentrations in complex biological samples. In this study, we developed a rapid and straightforward analytical method for the simultaneous determination of lactic acid and β -hydroxybutyric acid using matrix-assisted laser desorption/ionization time-of-flight mass spectrometry (MALDI-TOF MS). A peptide-based derivatization reagent was employed to enhance ionization efficiency through microwave-assisted micro-derivatization, enabling efficient detection without complicated sample preparation. All analytical procedures were performed on a microliter scale, requiring only 1 μ L of sample for analysis. The proposed method provided sensitive detection of both metabolites and demonstrated its potential applicability for acidosis-related biomarker analysis. As a non-enzymatic analytical approach, the method allows simultaneous monitoring of lactic acid and β -hydroxybutyric acid within a short reaction time. Compared with conventional LC-MS/MS methods, the MALDI-TOF MS platform eliminates the need for LC pumps, mobile phases, separation columns, and autosampler vials, while utilizing a reusable target plate, thereby reducing solvent consumption and improving energy efficiency. The primary objective of this pilot study was to demonstrate the feasibility of a rapid, microscale, high-throughput MALDI-TOF MS-based analytical platform with minimal sample consumption and simplified sample preparation. This method shows promise as a practical tool for rapid screening and preliminary clinical assessment of acidosis-related biomarkers.

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RSC-JAIMA Symposium 2026, MakuHari Messe, Chiba, Japan, September 3-4, 2026.

Development of Alkali Resistant Reversed Phase Column Packing Material Based on Eggshell Utilizing Layer-by-Layer Self-Assembly

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Porous silica gel is commonly used as a column packing material for reversed-phase liquid chromatography (RPLC) due to its high separation capacity. However, silica gel has the disadvantage that silica dissolves in alkaline mobile phases, leading to a decrease in separation efficiency. Therefore, there is a need to develop alkali-resistant column packing materials. We have previously developed an alkali-resistant packing material, Eggshell-PMaCO based on eggshell modified with amphiphilic polymer poly(maleic acid-*alt*-1-octadecene) (PMaCO)¹. A column packed with this material enabled the separation of basic compounds using alkaline mobile phase. However, compared to commercial silica gel columns, its retention capacity was relatively low due to the limited amounts of polymer components modified on the eggshell surface. In this study, layer-by-layer (LbL) method was employed to develop eggshell based column with enhanced retention capacity. Eggshell powder was alternately immersed in anionic PMaCO and cationic poly(diallyldimethylammonium chloride) (PDDA) electrolytes to form a multilayer organic membrane (Fig. 1). Particles were prepared using varying concentrations of the layering solution and different layering methods, and their physical properties were evaluated by thermogravimetric analysis and Fourier transform infrared spectroscopy. The prepared particles were packed into analytical column (ϕ 4.6 mm $\times$ 150 mm) by constant-pressure packing method, and the performance as reversed-phase column was evaluated. Chromatographic analysis of naphthalene confirmed that the columns with increased degree of surface modification exhibited stronger retention (Fig. 2) and improved symmetry factors. Further evaluation of column performance associated with increased surface modification, as well as the separation behavior for various compounds, will be thoroughly discussed in the presentation.

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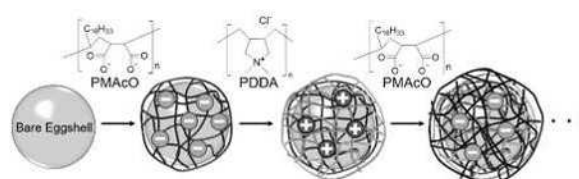


Fig. 1 Schematic illustration of LbL-modified particles

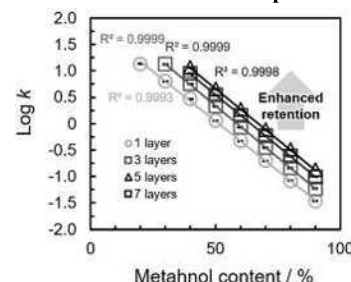


Fig. 2 Comparison of retention behavior

Water/methanol, 0.5 mL/min, 25 °C, 0.5 mg/mL naphthalene, 2 μ L, 254 nm

RSC-JAIMA Symposium 2026, MakuHari Messe, Chiba, Japan, September 3-4, 2026.

A simple dip–strip colorimetric sensor for on-site screening of GHB/GBL contamination in beverages

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Abstract A simple dip–strip colorimetric device was developed as a rapid screening platform for gamma-hydroxybutyric acid/gamma-butyrolactone (GHB/GBL) contamination. The device was fabricated on a nitrocellulose strip containing three functional regions: a ferric ion (Fe^{3+}) loading zone, a sodium hydroxide (NaOH) precipitation gate, and a potassium thiocyanate/potassium hydrogen sulfate ($\text{KSCN}/\text{KHSO}_4$) detection zone. In the absence of the target, free Fe^{3+} was precipitated as $\text{Fe}(\text{OH})_3$ at the NaOH zone, limiting its migration and suppressing formation of the red Fe-SCN complex. In contrast, the presence of GHB/GBL promoted soluble iron–analyte complex formation, allowing iron species to pass through the NaOH gate and react with SCN^- in the acidic detection zone to produce a visible orange-red signal. Replacing filter paper with nitrocellulose markedly improved reagent transport and enabled clearer color development within 10 min. Optimization of the precipitation gate showed that 0.5 M NaOH provided the best visual discrimination, whereas 0.25 M was insufficient to block free Fe^{3+} and 1 M excessively retained iron species. Under the optimized dip–strip format, the device was able to detect the target at 1 $\mu\text{g/mL}$, demonstrating its potential for simple, low-cost, on-site beverage screening.

RSC-JAIMA Symposium 2026, Makuhari Messe, Chiba, Japan, September 3-4, 2026.

Development of Extracellular Vesicle Analysis Technology Using Functionalized Cellulose Nanofiber Sheets

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Extracellular vesicles (EVs) are membrane-bound nanoparticles secreted from cells and have attracted attention as biomarkers for disease diagnosis and for understanding intercellular communication. However, efficient isolation and recovery of EVs from small-volume biological samples remain major technical challenges. To address this issue, our group has developed cellulose nanofiber (CNF) sheets for EV recovery¹. The CNF sheets possess a three-dimensional nanofiber network structure, in which nanoscale pores enable size-based EV capture from minute sample volumes. In this study, we aimed to further functionalize CNF sheets by introducing thiol groups and explored their potential as a platform for immobilizing functional materials, using gold nanoparticles as a model.

CNF sheets were fabricated by vacuum filtration of a CNF suspension onto a PTFE membrane filter with a pore size of 0.2 μm , followed by solvent exchange with isopropanol and hot pressing. For thiolation, 3,3'-dithiodipropionic acid and 1,1'-carbonyldiimidazole were dissolved in N,N-dimethylacetamide, and the CNF sheets were immersed in the reaction solution. After washing, the sheets were treated with ammonium thioglycolate solution to introduce thiol groups². Gold nanoparticles were then applied onto the thiolated CNF sheets by directly dropping the nanoparticle suspension onto the sheet surface.

The thiolated CNF sheets were characterized by Fourier-transform infrared spectroscopy, electron microscopy, and thiol quantification using DTNB, also known as Ellman's reagent. These analyses suggested successful thiol introduction while maintaining the nanofiber network structure. After gold nanoparticle addition, a visible color change of the suspension and sheet surface was observed, suggesting immobilization of gold nanoparticles onto the thiolated CNF sheets. Furthermore, fluorescence signals from EVs captured on the CNF sheets were enhanced after gold nanoparticle modification. These results indicate that thiolated CNF sheets can serve as a versatile platform for immobilizing functional nanomaterials. Functionalized CNF sheets may provide a useful basis for improving EV analysis, including enhanced detection sensitivity and integration of additional analytical functions.

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RSC-JAIMA Symposium 2026, Makuhari Messe, Chiba, Japan, September 3-4, 2026.

Laminated Microfluidic Paper-Based Analytical Device for Rapid Multiplex Water Quality Monitoring with Optimized Colorimetric Image Analysis

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Water contamination remains a major global challenge and requires rapid, portable, and cost-effective tools for on-site monitoring. In this study, we developed a laminated multilayer wax-printed microfluidic paper-based analytical device (μ PAD) for the simultaneous colorimetric determination of nitrite (NO_2^-), ferrous ions (Fe^{2+}), calcium (Ca^{2+}), and magnesium (Mg^{2+}), enabling comprehensive assessment of chemical contamination and water hardness in a single assay. The laminated architecture provides strong interlayer adhesion and controlled capillary-driven flow, effectively preventing reagent leakage, backflow, and layer separation, thereby improving analytical reliability. A key contribution of this work is the systematic evaluation of ten color spaces (RGB, CMYK, XYZ, Yxy, CIE Lab*, Hunter LAB, CIE Luv*, LCH, HSL, and HSV) for quantitative image analysis of μ PADs, providing an evidence-based strategy for optimizing colorimetric performance. The assay requires only 5 min and achieves limits of detection of 0.07 ppm for NO_2^- , 0.34 ppm for Fe^{2+} , 6.0 ppm for Mg^{2+} , and 9.0 ppm for Ca^{2+} . Validation using real water samples yielded recoveries of 77.3–126%, demonstrating satisfactory analytical accuracy and selectivity across diverse water matrices. The proposed laminated μ PAD integrates multiplex detection, optimized image analysis, and rapid operation into a portable platform with strong potential for on-site water monitoring.

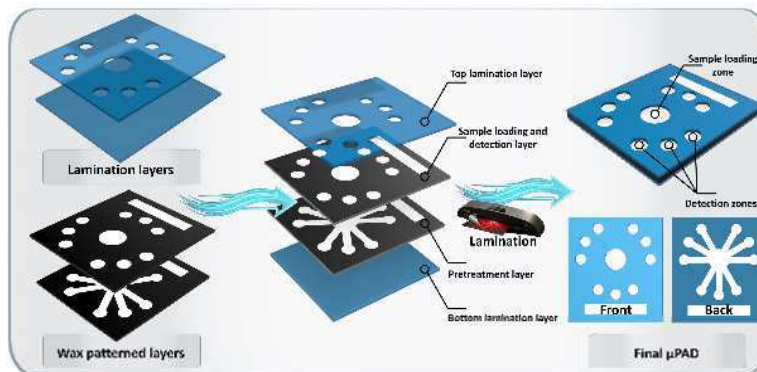


Figure 1. Schematic illustration of the device: the paper device was fixed using an adhesive spray and laminated with a polyvinyl chloride (PVC) sheet. The final configuration of the fabricated device is shown, including both front and back views.

RSC-JAIMA Symposium 2026, MakuHari Messe, Chiba, Japan, September 3-4, 2026.

pH-Responsive Deep Eutectic Solvent Extraction for Preservative Analysis in Oily Samples

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Abstract

Preservatives are added to products to prevent spoilage and extend shelf life. As concerns over potential health risks continue to grow, effective monitoring and regulation of these additives have become essential. For lipid-rich samples, sample preparation is a major bottleneck because high lipid content and hydrophobicity interfere with analyte transfer, phase separation, and chromatographic analysis. An effective strategy is needed to reduce matrix interference and extract target analytes from oily matrices efficiently.

Deep eutectic solvents (DESs), which are designer solvents composed of hydrogen-bond donors and acceptors, have emerged as promising alternatives to conventional organic solvents. Their tunable physicochemical properties allow them to be tailored for complex sample matrices and specific analytical targets. Based on these advantages, this study developed an in situ pH-responsive DES coupled with homogeneous liquid–liquid microextraction (in situ pH-DES-HLLME) for the determination of seven preservatives in oily matrices.

The main parameters were systematically optimized, and the target compounds were analyzed by narrow-bore liquid chromatography with UV detection. Under the optimized extraction conditions, the method shows good linearity with coefficients of determination greater than 0.999, and limits of detection were 0.02–0.80 $\mu\text{g/mL}$. The developed method was successfully applied to commercial vegetable oils and butter. In addition, its environmental performance was examined using a greenness evaluation tool, which indicated that the method offers a greener approach for sample preparation.

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RSC-JAIMA Symposium 2026, MakuHari Messe, Chiba, Japan, September 3-4, 2026.

A Point-of-care Semi-quantitative Device for Rapid Urine Glucose Detection

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Background Urinalysis plays an important role in the early detection of lifestyle-related diseases, including diabetes. Currently, urine test strips are the most widely used diagnostic tools. Although they enable rapid analysis, they suffer from limited accuracy. Therefore, there is a demand for devices allowing rapid quantitative point-of-care testing. As an alternative to test strips, we have previously reported a paper-based dip-and-read device¹. In this method, the extent of color change of an indicator corresponding to the target analyte concentration is evaluated using a semi-transparent color gradient film placed over the reaction area of the paper device, enabling quantitative measurements by the naked eye. In this work, we have adapted this system to an enzymatic assay targeting the detection of glucose in urine.

Concept A glucose concentration-dependent color change in an inkjet-printed line consisting of colorimetric enzymatic assay reagents is converted into a visible distance using a semi-transparent color gradient film. Because the length of the naked eye recognizable line (readout distance) varies with glucose concentration, the device enables quantitative measurements without any external equipment.

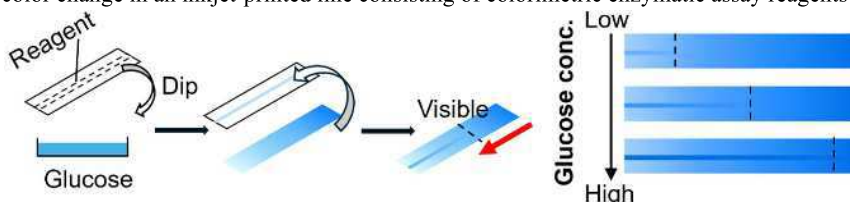


Fig. 1 Concept and assay workflow for the glucose detection device

Result First, optimization of glucose oxidase (GOx) and horseradish peroxidase (HRP) concentrations enabled clear and visually distinguishable color changes over a glucose concentration range of 0–300 mg/dL. In addition, adjustment of the HSL color space parameters allowed the selection of a suitable film color gradient, resulting in a readout distance that changed linearly with glucose concentration. User testing with the fabricated device demonstrated high linearity, with an R^2 value of 0.983.

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RSC-JAIMA Symposium 2026, Makuhari Messe, Chiba, Japan, September 3-4, 2026.

Development of Functional Porous PDMS Sponge for Selective Recovery of Platinum Group Metals

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¹ Science Tokyo, School of Mater. Chem. Technol.

² Science Tokyo, Zero-Carbon Energy

High-level liquid radioactive waste (HLLW) contains platinum group metals (PGMs) such as palladium (Pd), rhodium (Rh) and ruthenium (Ru), which are valuable resources in various fields of manufacturing industry, while they cause serious problems for the vitrification processes such as the formation of yellow phase, instability of the glass melter, and glass degradation [1,2]. To overcome such issues, effective separation of PGMs from HLLW is quite essential. PDMS (polydimethylsiloxane) having Si-O-Si backbone and three-dimensional macroporous structure is expected to be a valuable adsorbent. The adsorption-desorption behavior of target elements would be controlled by simple soaking solutions into PDMS sponge and squeezing of the sponge [3]. Therefore, in this study, I aim to create a new separation technique, enabling adsorption and desorption of PGM ions, by means of chemical and mechanical controls of a S-donor typed extractant-functionalized porous PDMS (polydimethylsiloxane) sponge.

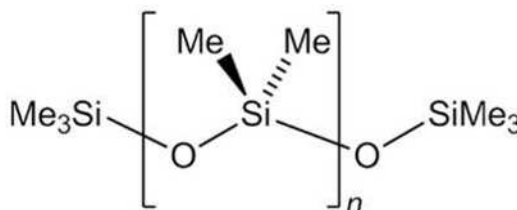


Figure. Chemical structure of PDMS (polydimethylsiloxane)

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RSC-JAIMA Symposium 2026, Makuhari Messe, Chiba, Japan, September 3-4, 2026.

Membrane Characterization of Supported Lipid Bilayers for Cell Culture Applications

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[Introduction]

Conventionally, cells are cultured on plastic or glass substrates; however, the surface properties of these materials differ substantially from those of the native cellular microenvironment. Since cellular functions such as proliferation and differentiation are strongly influenced by their surrounding environment, the development of biomimetic cell culture platforms is important for reproducing physiological cell behavior. In this study, we focused on supported lipid bilayers (SLBs), which provide a biomimetic interface owing to their phospholipid bilayer structure. SLBs are artificial lipid bilayers formed on solid substrates and have been widely used as model systems for cell membranes and membrane proteins, as well as in biosensing applications. However, depending on their lipid composition, SLBs may inhibit cell adhesion. Therefore, designing SLBs that support cell attachment is essential for their application as cell culture substrates. In this study, we investigate the membrane properties of SLBs as a first step toward understanding the relationship between membrane properties and cellular behavior.

[Results and Discussion]

The membrane properties of SLBs were characterized using fluorescence spectroscopy (**Fig.1**) with the membrane probes DPH and Laurdan. Membrane fluidity in the hydrophobic core was evaluated by DPH fluorescence anisotropy, while interfacial membrane hydration was assessed by Laurdan generalized polarization (GP). Cationic SLBs were prepared from the neutral lipid POPC and the cationic lipid DOTAP, and their membrane properties were investigated. Membrane fluidity remained nearly constant with increasing DOTAP content, whereas interfacial hydration decreased as the DOTAP fraction increased. Since this trend differed from that observed in lipid vesicles, the results suggest that the membrane properties of SLBs may be influenced by the underlying solid substrate. These findings provide fundamental insights into the membrane properties of SLBs and provide a foundation for future investigations into how membrane properties influence cellular behavior, contributing to the rational design of SLBs as biomimetic cell culture substrates.

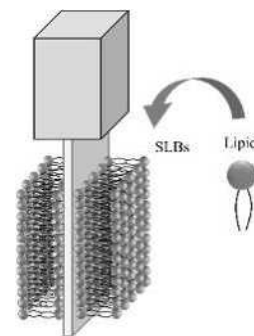


Fig. 1 Schematic of SLBs prepared for fluorescence spectroscopy

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RSC-JAIMA Symposium 2026, MakuHari Messe, Chiba, Japan, September 3-4, 2026.

Dynamic Prediction of Cyclodextrin Complex Formation Using Machine Learning with UV-Vis Absorption Spectra

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Cyclodextrins (CDs) are widely used as drug-delivery carriers because their hydrophobic cavities encapsulate guest molecules and improve solubility and stability [1]. Although quantitative structure–activity relationship / quantitative structure–property relationship (QSAR/QSPR) and machine-learning (ML) studies predict equilibrium complex stability [2], time-dependent formation remains difficult to analyze. In this study, ML was applied to time-resolved UV-Vis absorption spectra to predict the dynamic formation of CD inclusion complexes. β -CD and γ -CD were used as hosts, and Nile Red (NR), a hydrophobic guest molecule previously used in cyclodextrin encapsulation studies [3], served as a model guest.

Total CD and NR concentrations were 10 mM and 10 μ M, respectively, with five β -CD/ γ -CD ratios. The workflow in this study is illustrated in Fig. 1. UV-Vis spectra were measured from 200 to 800 nm, and the 400–800 nm region was used to train the ML models. Neural network (NN), support vector regression (SVR), and kernel ridge regression (KRR) models were compared using MSE, R^2 , peak errors, dynamic time warping, and coverage.

All models reasonably reproduced spectra in the interpolation range and peak-height trends, while peak-wavelength prediction was sensitive to outliers. KRR showed the best mean MSE and R^2 (0.0008 and 0.79) and captured local peak features, whereas NN was more stable. Low-variance regions at 500–550 nm and 600–650 nm, regarded as possible isosbestic regions, were reproduced more clearly by NN and KRR than by the measured spectra. These findings suggest that machine-learning-assisted reconstruction of time-resolved UV-Vis spectra offers a rapid, non-destructive framework for analyzing CD host–guest dynamics and supporting DDS formulation design.

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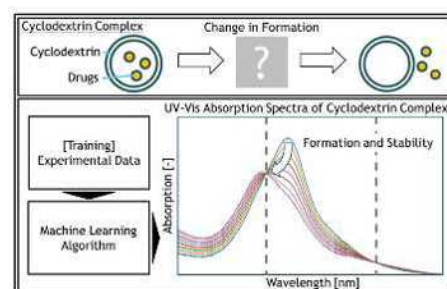


Fig. 1 Schematic of machine-learning-assisted dynamic prediction of cyclodextrin inclusion complex formation from UV-Vis absorption spectra.

RSC-JAIMA Symposium 2026, MakuHari Messe, Chiba, Japan, September 3-4, 2026.

Machine Learning Prediction of Binding Affinity for Alzheimer's Disease-Related Amyloid- β Proteins

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Alzheimer's disease (AD) is a major neurodegenerative disorder strongly associated with the aggregation and fibrillization of amyloid-beta ($A\beta$) proteins. Small molecules that bind to $A\beta$ fibrils are promising candidates for inhibiting aggregation, but experimental screening of large compound libraries remains costly and time-consuming. We developed a machine-learning workflow to predict the binding affinity of small molecules for AD-related $A\beta$ proteins and to support rapid virtual screening.

Compounds with reported activity against $A\beta$ were collected from the ChEMBL database [1] and filtered by chemical structure and activity records as shown in Fig.1. For each ligand, docking scores were calculated with AutoDock Vina [2] using the $A\beta$ fibril structure as a receptor, and the resulting binding energies were used as training labels. Molecular representations were constructed by combining 2048-bit Morgan fingerprints, which encode local structural information, with RDKit two-dimensional physicochemical descriptors, including molecular weight, LogP, polar surface area, and rotatable bonds.

Several combinations of algorithms and features were evaluated, including deep neural networks, random forests, and XGBoost [3]. The proposed XGBoost model with hybrid features achieved the best performance, with an R^2 score of 0.698 and an RMSE of 0.421 kcal mol⁻¹ for the test set. These results indicate that integrating structural fingerprints and physicochemical descriptors effectively captures molecular factors governing $A\beta$ binding and provides a fast surrogate model for docking-based screening. The approach may help prioritize candidate compounds for AD drug discovery while reducing the computational and experimental cost of early-stage screening.

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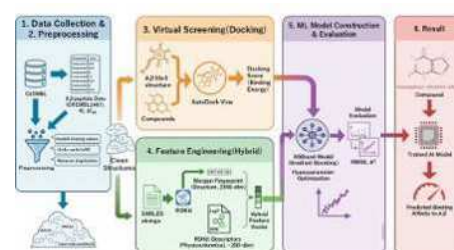


Fig. 1 Machine-learning workflow to predict the binding affinity of small molecules for Alzheimer's disease-related amyloid- β proteins.

RSC-JAIMA Symposium 2026, Makuhari Messe, Chiba, Japan, September 3-4, 2026.

Mid-infrared laser absorption spectroscopy with feature extraction for real-time, high-precision multi-component gas sensing

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We have developed a mid-infrared laser-based gas sensor using an original spectroscopic method called infrared laser absorption modulation (IRLAM™)* [1]. Conventional spectral curve fitting provides high-accuracy gas analysis; however, it requires substantial computation time and often demands a high-performance computer for real-time operation. In contrast, IRLAM extracts feature quantities from absorption signals by correlating them with predetermined reference signals, and the extracted features are used to estimate target gas concentrations while compensating for interference and other measurement perturbations. By replacing absorption signals consisting of several hundred data points with a small number of feature quantities, IRLAM dramatically reduces the computational load, enabling real-time processing on an embedded board.

In this report, we demonstrate real-time, high-precision multi-component gas measurements using the IRLAM method. Fig. 1 shows the experimental configuration of the IRLAM gas sensor. The system employs four pulsed quantum cascade lasers (QCLs), each tuned to the absorption peak of a target gas, enabling simultaneous multi-component sensing [2]. Fig. 2 shows the measured concentration values of NH_3 and N_2O with and without interfering gases. The results indicate that IRLAM can suppress interference effects and maintain accurate concentration determination, demonstrating its capability as a real-time, high-precision gas sensing technique.

*IRLAM is a registered trademark or trademark of HORIBA, Ltd. in Japan and other countries.

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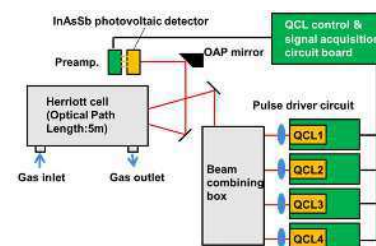


Fig. 1 Experimental configuration of the IRLAM gas sensor.

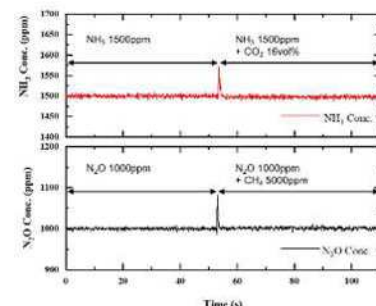


Fig. 2 Concentration value of NH_3 and N_2O measured by the IRLAM gas sensor.

RSC-JAIMA Symposium 2026, Makuhari Messe, Chiba, Japan, September 3-4, 2026.

Analysis of aroma compounds in grated garlic using a structure analysis method utilizing machine learning

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¹JEOL Ltd.

Garlic is widely used to impart flavor to foods, and multiple compounds, particularly sulfur-containing compounds, have been reported to contribute to its characteristic aroma. In qualitative analysis of aroma compounds by GC-MS, compounds are commonly estimated by comparing measured EI mass spectra with spectra registered in the NIST database (DB) and evaluating spectral similarity. However, because aroma compounds are highly diverse, they cannot always be fully explained by compounds registered in the NIST DB alone. This is particularly true for grated garlic, in which diverse volatile compounds are generated through enzymatic reactions and subsequent compositional changes caused by crushing. Therefore, grated garlic is likely to contain many compounds that are not registered in the NIST DB, making it difficult to fully understand its aroma characteristics based only on known compounds.

Because the number of compounds registered in the NIST DB represents only a small fraction of the enormous number of compounds available in PubChem, structural estimation of unregistered compounds is time-consuming. Therefore, we developed a machine learning model constructed from EI mass spectral data in the NIST DB to create a library of predicted EI mass spectra from chemical structures registered in PubChem. This technology was originally developed for GC-TOFMS and was subsequently applied to GC-QMS. As a result, it became possible to perform structural estimation even for unknown compounds for which conventional database searches provide only limited candidate information. The aim of this study was to analyze aroma compounds in grated garlic using this technology and to clarify the characteristics of the compounds contributing to its aroma.

In the analysis, candidate compounds were narrowed down by combining EI spectral similarity, molecular weight confirmation by photoionization (PI), and comparison of retention index (RI). In grated garlic, known sulfur-containing compounds such as Diallyl disulfide, 3-Vinyl-4H-1,2-dithiin, and Diallyl trisulfide were suggested as major components characteristic of garlic aroma. Several compounds showed low similarity to EI mass spectra registered in the NIST DB and were considered likely to be unregistered compounds. For these compounds, structural estimation was performed by comparison with EI mass spectra predicted using machine learning, resulting in candidate structures like Diallyl disulfide.

This analytical approach provided candidate structures even for compounds that could not be sufficiently characterized using the NIST DB alone, enabling the interpretation of aroma compounds in grated garlic, including unknown compounds. Therefore, this technology can be utilized as an approach for interpreting unknown compounds in GC-MS analysis.

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Development of Sustainable Nicotinic Acid-Functionalized Chito-Oligosaccharide Ti/Si Hybrid Monolithic Capillary Columns for Multifunctional Mixed-Mode and Chiral Separations

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The growing demand for sustainable analytical methodologies has encouraged the development of green chromatographic materials with multifunctional selectivity and improved stability. Chito-oligosaccharides are promising renewable materials due to their biodegradability, hydrophilicity, cationic character, and chiral recognition properties. In this study, a novel nicotinic acid-functionalized chito-oligosaccharide bonded TiO₂/SiO₂ hybrid monolithic capillary column (COS-N Ti/Si) was developed as a sustainable mixed-mode and chiral stationary phase for chromatographic separations. The monolith was prepared through a sol-gel co-gelation approach after pretreatment of the fused silica capillary with a water-resistant titania layer to improve monolith anchoring and hydrolytic stability. Controlled hydrolysis of titanium and silica precursors produced a homogeneous porous structure with suitable morphology and permeability. The fabricated monolith was characterized using SEM, EDX, XRD, and ATR-FTIR. The COS-N Ti/Si column exhibited effective selectivity toward nucleobases, nucleosides, carbamate pesticides, strobilurin fungicides, and chiral pesticides. Functional amino, hydroxyl, and pyridine groups enabled hydrophilic-electrostatic interactions, hydrogen bonding, π - π interactions, and chiral recognition. Molecular docking and molecular dynamics simulations further clarified analyte-stationary phase interactions and supported the observed selective retention and enantioselectivity.

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RSC-JAIMA Symposium 2026, MakuHari Messe, Chiba, Japan, September 3-4, 2026.

Multiple Ordered Solvent Environments in Lipid Membrane Investigated by DAN Probes

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[Introduction]

Three analogue solvatochromic probes, Acдан, Prodan, and Laurdan, are extensively used in the study of biological sciences. Their locations into lipid membranes vary greatly in depth, and the fluorescence responds to their surrounding environment based on their respective location in the membrane. The analytical approach in time-resolved emission spectrum (TRES) using fluorescence lifetimes (τ) and emission peaks (λ) called τ and λ plot is an effective tool to assess the distributions of different solvent environments in the lipid membranes^{1,2}. Herein, τ and λ plot was conducted using the aforementioned probes to expand the analytical field according to their location. Furthermore, the solvent modeling¹⁻³ for the τ and λ plot analysis was conducted to artificially emulate the complex environment in lipid membranes by utilizing a series of solvent mixtures to assess the contribution of biophysical properties to each distribution.

[Results and Discussion]

From a series of solvent mixtures, the effect of solvent viscosity to lifetime values was confirmed in the short lifetime region (~ 3 ns). However, it was impossible to reconstruct the long lifetime values (4 ns $\sim$) observed in lipid membranes. From the insight of the limiting anisotropy (r_∞), the τ and λ plot was divided into a solvent-like region with isotropic environment ($r_\infty < 0.15$) and a highly ordered region enough to define as anisotropic environment ($0.15 < r_\infty$) at τ : 4ns. The membrane-specific distribution was illustrated from this work (Fig.1). An analytical model was conducted to visualize multiple fluorescence components of each probe in several lipid membranes, confirming the different distributions between these probes. Our results well-illustrated the multiplicity of lipid environments modeled with solvent and ordered environments in each lipid membrane.

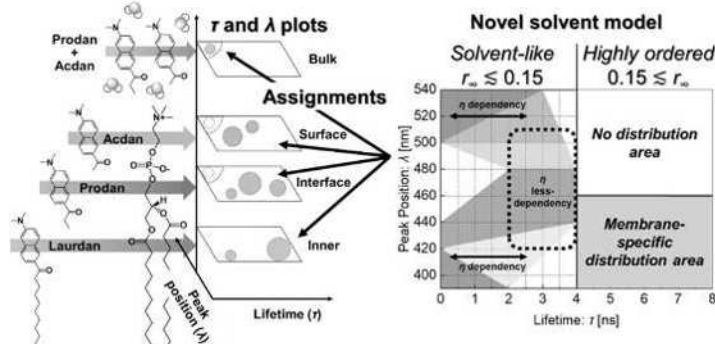


Fig.1 Schematic illustration of analytical solvent model

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RSC-JAIMA Symposium 2026, Makuohari Messe, Chiba, Japan, September 3-4, 2026.

Distance-Based Capillary-Driven Microfluidic Devices for On-Site Coffee Analysis

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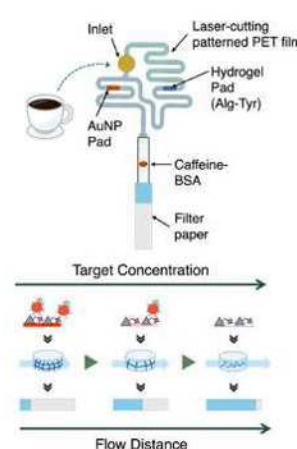
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Coffee is a globally consumed beverage that requires monitoring for both safety and quality. It is a major exposure source for Ochratoxin A (OTA), a highly toxic mycotoxin [1], and the main source of dietary caffeine [2]. Conventional detection methods rely on sensitive but complex and time-consuming instrumental approaches. Besides, while lateral flow immunoassays are rapid, they still require external readers for quantitative result interpretation. Therefore, there is an urgent need for on-site, user-friendly analytical devices to achieve equipment-free quantification of analytes in coffee.

To address this problem, we propose a novel microfluidic analytical device via a distance-based, naked-eye readout strategy. The integrated device has three functional modules: a liquid control module for automated reagent delivery, an immunoassay module for target recognition, and a readout module for signal transduction. Mechanistically, the assay utilizes gold nanoparticles conjugated with specific antibodies and horseradish peroxidase (Ab-HRP@AuNP). The analytes are first captured by Ab-HRP@AuNP, after which the unbound probes are captured on an antigen-coated test line. Subsequently, a solution containing alginate-tyramine (Alg-Tyr) conjugates and H₂O₂ is introduced. The HRP on Ab-HRP@AuNP on the test line catalyzes the cross-linking of Alg-Tyr, altering the microfluidic permeability and thereby translating the analyte concentration into a visual distance signal.

In this work, we designed a capillary-driven film-based microfluidic device as a liquid control module to achieve timed, sequential liquid delivery. Then, we synthesized alginate-tyramine (Alg-Tyr) conjugates and investigated the effects of different EDC/NHS concentrations on the conjugation process, and we also evaluated the gelation of Alg-Tyr under different pH conditions, H₂O₂ concentrations and HRP concentrations. Furthermore, we optimized the ratio of HRP to antibody (Ab) during probe synthesis. Next, we will further optimize the assay parameters and integrate the system for the equipment-free quantification of analytes in coffee.



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RSC-JAIMA Symposium 2026, Makuohari Messe, Chiba, Japan, September 3-4, 2026.

Vascular Network Formation in a Perfused Well System

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Japan Woman's University

1. Introduction

Our laboratory aims to construct vascular networks by culturing Normal Human Dermal Fibroblasts (NHDFs) on Human Umbilical Vein Endothelial Cells (HUVECs) in a well [1]. Since angiogenesis in vivo is regulated by physical stimuli such as interstitial flow, we developed a three-dimensional culture system that enables continuous medium perfusion. To investigate whether perfusion enhances vascular network formation, cultures under perfusion conditions were compared with those under conventional static conditions.

2. Experiment

A two-layer gelatin well was fabricated. For the upper well (8 mm in diameter and 5 mm in height), a 10% gelatin solution containing transglutaminase (mTG) was cross-linked in a PDMS mold at 37°C for 3 hours. The lower well consisted of a 1-mm-thick gelatin sheet prepared from the same solution, into which a 4-mm-diameter hole was punched using a biopsy trephine. The upper well, lower well, and glutaraldehyde (GA)-modified coverslip were assembled and bonded using a food-grade adhesive at 37°C for 2 h. For perfusion culture, tubing connected to a syringe pump was attached to the upper well, and a 150- μ m capillary was temporarily inserted between the lower well and the coverslip to create a perfusion pathway.

The well surface was modified with amino silane and glutaraldehyde, followed by gelatin coating. NHDFs were seeded as a monolayer into the lower well, followed by HUVECs the next day. Five hours later, NHDFs—at approximately eight times the cell counts of the HUVECs—were seeded, and the cells were cultured for 72 hours. In the perfusion culture, the capillary was removed after cell attachment, and the culture medium was perfused at 0.02 mL/h. Vascular network formation was evaluated by VE-cadherin immunostaining.

3. Results and Discussion

The developed well enabled stable medium perfusion, allowing cell culture under flow conditions. Partial vascular network formation was observed under both static and perfusion conditions; however, distinct vascular networks were not obtained. No significant difference was found between the two culture conditions, although perfusion was expected to enhance vascular network formation. This result suggests that the applied flow rate may have been insufficient to promote vascular network formation. Future studies will investigate the effects of higher perfusion flow rates on vascular network formation.

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RSC-JAIMA Symposium 2026, Makuhari Messe, Chiba, Japan, September 3-4, 2026.

Flow Behaviors and Calculation Results of Capillary-Driven Flow in a Triangular Nanofluidic Channel with Heterogeneous Semiconductor Materials

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Capillary-driven flow enables passive liquid transport in nanofluidic systems without the need for external pumping. In this study, hollow triangular nanochannels composed of heterogeneous semiconductor materials were fabricated using nanoimprint lithography. To evaluate their liquid transport capability, methanol–ethanol mixtures, EDTA, and PBS were introduced into exposed nanofluidic channel cross-sections, and the flow behavior was recorded using a smartphone. Contact angles of the test liquids on GaN and Si₃N₄ surfaces were also measured. Furthermore, fundamental fluidic equations were applied to determine the average velocity, flow rate, capillary force, pressure drop, and shear stress. The results showed that the average flow velocity ranged from 1 to 15 μ m/s, the capillary force from 0.46 to 1.27 MPa, the pressure drop from 27 to 113 Pa, and the shear stress from 1.32 to 3.65 Pa, depending on the test liquid. These findings demonstrate successful capillary-driven transport in heterogeneous semiconductor nanofluidic channels and provide a quantitative database for future device design and fabrication optimization.

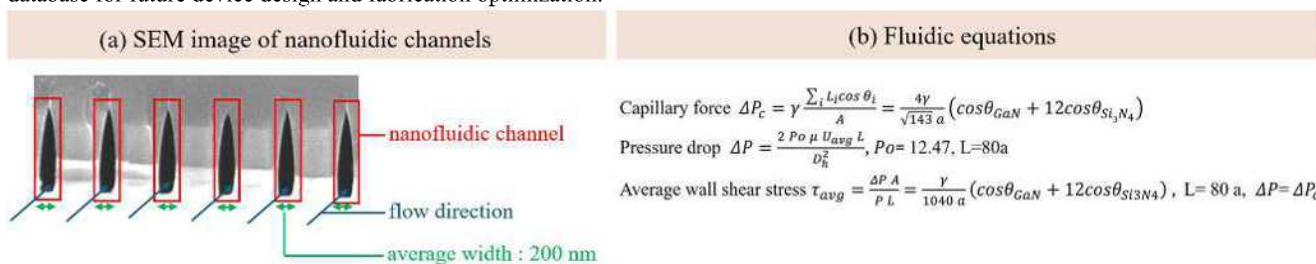


Figure 1. (a) SEM image of triangular nanofluidic channels with heterogenous semiconductor and (b) fluidic equations were applied to calculate capillary force, pressure drop and average wall shear stress in this study.

RSC-JAIMA Symposium 2026, Makuhari Messe, Chiba, Japan, September 3-4, 2026.

An analytical MALDI-DIT-MS workflow for oligonucleotide therapeutics

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Abstract: In various processes from the development of oligonucleotide therapeutics to clinical trials and practical use, there is a need for technologies that can be used to analyze oligonucleotide therapeutics more easily and rapidly. Matrix-assisted laser desorption/ionization mass spectrometry (MALDI-MS) allows simple analysis by detecting various compounds mainly as singly charged ions. Furthermore, MALDI-digital ion trap mass spectrometry (MALDI-DIT-MS) enables detailed structural analysis by the MSⁿ function. Herein, we report an analytical MALDI-DIT-MS workflow for oligonucleotide therapeutics including antisense oligonucleotides (ASOs), phosphorodiamidate morpholino oligomers (PMOs), and small interfering RNAs (siRNAs).

MALDImini™-1 (Shimadzu Corporation) was used as a MALDI-DIT mass spectrometer. Model analytes bearing sequences similar to those of the oligonucleotide therapeutics nusinersen, viltolersen, eteplirsen, and vutrisiran were used. MALDI matrices appropriate for each analyte and analytical purpose were used. Matrix solutions were prepared by dissolving in acetonitrile/water (50/50, v/v) containing ammonium citrate dibasic. LabSolutions Insight™ Biologics (Shimadzu Corporation) was used for sequencing of ASOs.

ASOs were detected predominantly as [M+H]⁺, and numerous fragment ions were generated by in-source decay (ISD). The resulting ISD spectra were rapidly sequenced using Insight Biologics software based on the dominant ion species *a*- and *w*-ions. PMOs were detected as [M+H]⁺ and the ISD generated multiple fragment ions that were assigned to *b*- and (*x*-10)-ions, corresponding to phosphorodiamidate bond cleavage. ISD of the PMOs using alkylated trihydroxyacetophenone as a matrix produced only *b*-ions retaining terminal PEGylation, and subsequent MS² and MS³ of the *b*-ion provided detailed structural information on the terminal PEGylation. siRNAs were detected as [M+H]⁺ and ISD produced numerous fragment ions as well as four peaks separated by 203 Da, consistent with GalNAc residues. MS² and MS³ of the four peaks provided structural information on the terminal GalNAc modification. These results demonstrate a simple MALDI-DIT-MS workflow for molecular-weight determination, sequence elucidation, and terminal-modification analysis of oligonucleotide therapeutics.

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RSC-JAIMA Symposium 2026, Makuhari Messe, Chiba, Japan, September 3-4, 2026.

Platinum Nanoflower-Based Electrochemical Sensors for Real-Time Cellular Activity Monitoring and Glucose Analysis

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Abstract

For this study, we developed a platinum nanoflower (nP)-based electrochemical sensor for glucose detection and real-time cellular activity monitoring. The nP film was fabricated through a simple electrodeposition process, producing a highly active surface with excellent electrochemical properties. The sensor demonstrated high glucose sensing performance in phosphate-buffered saline (PBS), achieving a sensitivity of 81.9 $\mu\text{A cm}^{-2} \text{ mM}^{-1}$ along with good selectivity against interfering species. In addition to glucose analysis, the nP electrode was further applied to monitor cellular metabolic activity by tracking glucose consumption in solution. Chronoamperometric measurements were used to evaluate the concentrations of both *Escherichia coli* (*E. coli*) and MCF-7 cancer cells through their glucose uptake behavior. As the concentration of *E. coli* increased from 10^4 to 10^6 CFU mL^{-1} , the electrochemical response showed a clear linear decrease in charge, yielding a strong correlation coefficient ($R^2 = 0.999$). A similar linear relationship was observed for MCF-7 cells within the range of 10^3 to 10^5 CFU mL^{-1} ($R^2 = 0.943$). These results demonstrate that the platinum nanoflower platform provides a straightforward and reliable approach for both glucose sensing and indirect cellular activity analysis. The proposed system shows strong potential for future biosensing applications involving bacterial detection, cancer cell monitoring, and metabolic analysis.

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Molecular Dynamics Insights into NSAID Adsorption on a Hydrophobic Deep Eutectic Solvent-Coated Silica Sorbent

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Abstract

A hydrophobic natural deep eutectic solvent-coated silica sorbent was developed by functionalising silica with n-octyltriethoxysilane followed by immobilisation of a thymol:oleic acid deep eutectic solvent (DES). Spectroscopic and microscopic characterisation confirmed successful surface modification and formation of a DES-rich organic interfacial layer. The adsorption performance of DES-SOT toward diclofenac, ibuprofen, mefenamic acid, and tolfenamic acid was evaluated under competitive aqueous conditions. DES-SOT exhibited enhanced adsorption performance compared with unmodified silica and Si-OTES, with rapid adsorption equilibrium achieved within 20 min at near-neutral pH. Kinetic and equilibrium studies indicated heterogeneous adsorption behaviour dominated by physisorptive interactions and hydrophobic partitioning within the immobilised DES layer. Molecular dynamics simulations were employed to elucidate analyte-specific interactions within the hydrophobic DES microenvironment and provided molecular-level insight into the adsorption mechanism. The simulations revealed distinct association behaviours among the NSAIDs, where stronger NSAID-DES interactions corresponded to improved adsorption performance observed experimentally. DES-SOT also demonstrated good reusability and maintained adsorption capability across different water matrices. Overall, the study demonstrates how the integration of computational molecular modelling with experimental analytical chemistry can provide mechanistic understanding for the rational design of DES-based sorbents for pharmaceutical adsorption in water.

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Analysis of the Effects of Intermolecular Interactions on the Electronic States of Liquid Alcohols by ATR-FUV Spectroscopy

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Intermolecular interactions, particularly hydrogen bonding, play an essential role in determining the physical properties and molecular structures of liquid alcohols. However, the influence of these interactions on the electronic states in the far-ultraviolet (FUV) region has not been fully understood. In this study, attenuated total reflection far-ultraviolet (ATR-FUV) spectroscopy was employed to investigate the effects of intermolecular interactions on the electronic states of liquid alcohols.

In our previous study [1], the absorption band observed at approximately 145 nm in n-alkane was assigned to the σ -Rydberg transition. In the present study, an additional absorption band was observed around 160 nm. Comparison with time-dependent density functional theory (TD-DFT) calculations suggested that this band originates from an n-Rydberg transition due to the OH moiety. Furthermore, analysis of the concentration dependence revealed systematic changes in the absorption bands near 145 and 160 nm, indicating that intermolecular interactions influence both the σ -Rydberg and n-Rydberg electronic transitions.

To further investigate the origin of these spectral changes, near-infrared (NIR) spectroscopy was used to evaluate changes in the hydrogen-bonding state. The NIR results were compared with the electronic-state changes observed by ATR-FUV spectroscopy. A correlation was observed between the variations in the hydrogen-bonding state and those in the ATR-FUV spectra, demonstrating that changes in hydrogen bonding influence both the σ -Rydberg and n-Rydberg transitions.

These results demonstrate that the combination of ATR-FUV and NIR spectroscopy enables a comprehensive evaluation of the relationship between intermolecular interactions, hydrogen-bonding states, and electronic states in liquid alcohols. Consequently, this combined methodology provides an effective approach for investigating intermolecular interactions within hydrogen-bonded liquid systems.

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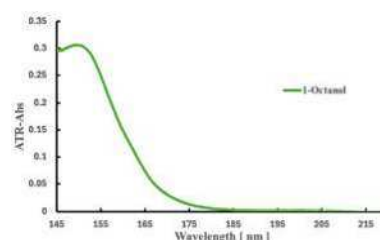


Figure1:ATR-FUV spectrum of liquid 1-Octanol.

RSC-JAIMA Symposium 2026, MakuHari Messe, Chiba, Japan, September 3-4, 2026.

Analysis of urushiol in Japanese lacquer sap

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Abstract Because Japanese lacquer forms a beautiful and elegant coating, countless lacquerware and lacquered buildings have been created since ancient times.[1, 2] They still retain their elegance, and many of them have been designated as National Treasures or World Heritage Sites. On the other hand, because lacquer takes a long time to dry and requires skilled craftsmanship, the industrialization of its production has not been developed much until now. However, there has been steady progressing in the recent research on Japanese lacquer as a sustainable material for industrial use. The composition of Japanese lacquer sap is shown in the table. As shown in the table, the main component is urushiol. Japanese lacquer forms a beautiful coating through the oxidative polymerization of urushiol, its main component.[3] As part of our applied research into the industrial use of Japanese lacquer, we analyzed urushiol — the main component of Japanese lacquer — using mass spectrometry (MS) and nuclear magnetic resonance spectroscopy (NMR). As a result, the main component of urushiol was successfully identified as 3-(8'Z,11'E,13'Z-pentadecatrienyl)catechol.

Table The composition of Japanese lacquer sap

components	%
urushiol	66-76
water	18-26
plant gum	5-7
Glycoprotein	3-5
laccase enzyme	1-2

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RSC-JAIMA Symposium 2026, MakuHari Messe, Chiba, Japan, September 3-4, 2026.

Green-Synthesized TiO₂ Nanoparticles from *Annona muricata* Peel Extract: Comparative Physicochemical Characterization and Preliminary Photocatalytic Evaluation Against Paracetamol

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Abstract Paracetamol (PCT) is a widely consumed analgesic classified as an emerging pharmaceutical micropollutant due to its persistence in aquatic environments and resistance to conventional wastewater treatment; TiO₂-based photocatalytic advanced oxidation processes offer a promising remediation route, and green synthesis via plant extracts provides a sustainable alternative to hazardous chemical methods, yet the influence of extraction solvent polarity on nanoparticle properties and photocatalytic performance remains insufficiently explored for tropical bioresources such as *Annona muricata* peel. This study synthesized TiO₂ nanoparticles via sol-gel using titanium(IV) isopropoxide mediated by aqueous (TiO₂-EA) and ethanolic (TiO₂-EE) extracts of *A. muricata* peel, characterized both samples by XRD, FTIR, UV-DRS Tauc plot, and FESEM-EDS, and evaluated preliminary photocatalytic activity against 15 mg/L PCT under UV-C irradiation ($\lambda = 254$ nm) for 180 min. Both samples yielded pure anatase-phase TiO₂ with similar primary crystallite sizes (8.6 nm vs. 9.9 nm); UV-DRS Tauc plot analysis revealed markedly different optical bandgap energies (3.21 eV for TiO₂-EA vs. 3.40 eV for TiO₂-EE), and FESEM confirmed agglomerated spherical morphology in both; in preliminary photocatalytic evaluation, TiO₂-EE achieved greater PCT removal efficiency than TiO₂-EA despite its wider optical bandgap, with both outperforming control TiO₂ and direct UV-C photolysis. This counter-intuitive result suggests that surface physicochemical properties conferred by ethanolic phytochemical capping agents are a more decisive determinant of photoactivity than bandgap energy alone, positioning *A. muricata* peel as a promising tropical bioresource for green TiO₂ synthesis.

Keywords: Green synthesis; TiO₂ nanoparticles; *Annona muricata*; paracetamol; photocatalysis; UV-DRS; bandgap energy; sol-gel; solvent polarity

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A Microfluidic Tumor Cell Spheroid Array for Parallel Evaluation of Nanoparticle Uptake

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In cancer chemotherapy, nanomedicines have been extensively studied to deliver antitumor drugs selectively to a tumor tissue. To evaluate their efficacy, three-dimensionally cultured tumor cell spheroids are highly useful as they accurately reflect the in vivo tumor microenvironment [1]. In our previous study [2], we demonstrated a nanoparticle uptake assay using a microfluidic device integrated with a track-etched porous membrane, where a spheroid was embedded in a fibrin gel. However, the narrow microchannel limited the capture capacity to only about three spheroids, resulting in low throughput. In this study, we developed an improved microfluidic device by expanding the microchannel and redesigning the trap arrangement to efficiently array over ten spheroids, aiming to construct a tumor model capable of parallel evaluation of polyion complex vesicle (PICsome) [3] uptake. The microfluidic device was fabricated via a simple, photolithography-free approach based on our previous report [2]. A mold was fabricated using a consumer CO₂ laser cutter by cutting an acrylic plate and engraving approximately 120 µm-deep microdepressions to form the trap structures. Human breast cancer MDA-MB-231 cells were cultured into spheroids via the hanging drop method. The spheroids were introduced into the central channel with fibrin gel and allowed to settle. Subsequently, a suspension of fluorescently labeled PICsomes [3] was introduced from an adjacent channel through the porous membrane under pressurized flow to expose the spheroids. After overnight incubation, the channels were washed with a buffer solution, followed by phase-contrast and fluorescence microscopic observation. Cellular uptake was quantitatively evaluated by calculating the normalized fluorescence intensity. By optimizing the trap geometry and arrangement, we successfully captured approximately 15 spheroids per device. Furthermore, nanoparticle exposure and washing via pressurized flow were performed on the developed device. The spheroids exhibited a significant increase in normalized intensity after exposure, indicating successful nanoparticle uptake into tumor cells. In conclusion, this membrane-integrated microfluidic device effectively simulates the permeation process of nanoparticles from the vascular wall to the interstitium and tumor cells, achieving parallel analysis of a significantly larger number of spheroids compared to our previous study [2]. This device holds great promise as a powerful tool for the efficient efficacy evaluation of novel nanomedicines such as PICsomes.

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RSC-JAIMA Symposium 2026, MakuHari Messe, Chiba, Japan, September 3-4, 2026.

Integration of Preconcentration Chip with FET Biosensor for Acute Respiratory Distress Syndrome Detection

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Abstract A This study presents a microfluidic platform for the detection of Serum Amyloid A1 (SAA1), a key biomarker of Acute Respiratory Distress Syndrome (ARDS). As SAA1 appears early in disease progression at extremely low concentrations, enhancing detection sensitivity and lowering the limit of detection (LOD) are critical for timely diagnosis. To visualize the preconcentration process, calcein was employed as a fluorescent tracer. An electric field applied to bipolar electrodes induced Faradaic reactions, generating ion concentration gradients and electroosmotic flow, which drove charged molecules to accumulate within designated regions. The microfluidic chip was fabricated by producing SU-8 molds, casting polydimethylsiloxane (PDMS) channels, and integrating gold electrodes and signal lines onto an acrylic substrate. The PDMS layer was bonded to the substrate and connected to a printed circuit board. A field-effect transistor (FET)-based biosensor was incorporated for electrical signal readout, enabling a compact device with both preconcentration and detection capabilities. Preconcentration efficiency and zone displacement were first characterized under varying voltages. Anti-SAA1 antibodies were then immobilized on gold electrodes to create a specific biosensing interface for detecting antigen-antibody interactions. Finally, preconcentration and biosensing were integrated into a single chip to evaluate improvements in detecting ultra-low SAA1 concentrations. The results demonstrated strong preconcentration performance and sensitive electrical detection, highlighting the platform's potential for early ARDS screening and analysis of low-abundance biomarkers.

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Ionic Liquid Chelate Extraction Behavior of Divalent Metal Ions with Acylpyrazolones

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Introduction: In ionic liquid (IL) chelation extraction using a β -diketone, thenoyltrifluoroacetone (Htta $pK_a = 6.18$) with a CF_3 group, several divalent metal ions are extracted as 1:3 anionic complexes through anion-exchange extraction process. However, it is unclear which part of Htta is involved in the extraction. In this study, we used two β -diketone-type acylpyrazolones, 4-benzoyl-3-methyl-1-phenyl-5-pyrazolone (Hbmpp, $pK_a = 4.02$, Fig. 1) and 4-trifluoroacetyl-3-methyl-1-phenyl-5-pyrazolone (Htmpp, $pK_a = 2.87$, Fig. 2), as extractants for the divalent metal ions. The former shows suitable acidity without CF_3 , and the latter is more acidic with CF_3 .

Experimental: An Extraction was performed by shaking 5 mL of an aqueous phase containing a divalent metal ions (M(II), where M = Cu, Ni, Cd, Zn, Co, Mn) with 1 mL of an extraction phase ($C_n\text{mimTf}_2\text{N}$ ($n=2,4,8$, Fig. 3) or $CHCl_3$) containing 0.01 M Hbmpp or Htmpp. After that, the metal concentrations in both phases were determined using atomic absorption spectrophotometer. (That in the extraction phase was measured after back-extraction into 1.0 M HNO_3 .)

Results and Discussion: For all divalent metal ions, IL extraction phase showed higher extraction efficiency than $CHCl_3$. The order of the efficiency between extractants was $Htmpp > Hbmpp (> Htta)$, which corresponded to acidity order. In using Hbmpp, Cu(II), Ni(II) and Co(II) were extracted as 1:2 neutral complexes, whereas Zn(II), Mn(II) and Cd(II) were extracted as 1:3 anionic ones. In use of Htmpp, on the contrary, Cu(II) was extracted 1:2 neutral complex, whereas Co(II) and Cd(II) were extracted as 1:3 anionic ones. These results, especially for Co(II), suggested that the presence CF_3 group in extractant may contribute the anion-exchange.

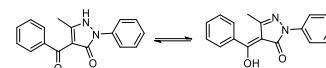


Fig. 1 Hbmpp

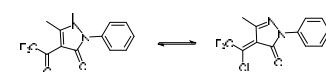


Fig. 2 Htmpp

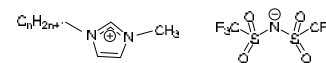


Fig. 3 $C_n\text{mimTf}_2\text{N}$

RSC-JAIME Symposium 2026, MakuHari Messe, Chiba, Japan, September 3-4, 2026.

A Self-Exchanging Anthraquinone Gallery Reconstructs NiFe-LDH for Durable Oxygen Evolution in Chloride Electrolyte

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Abstract The oxygen evolution reaction (OER) largely governs the energy efficiency and operating voltage of water electrolysis, but attaining both high activity and long-term durability in chloride-containing environments remains difficult due to catalyst corrosion and competition from the chlorine evolution reaction. NiFe layered double hydroxides (NiFe-LDHs) are among the most active non-precious OER catalysts in alkaline media, yet in chloride-rich, seawater-type electrolytes they degrade rapidly through iron dissolution and framework collapse. Instead of pre-installing a fixed protective interlayer anion, we introduce a dynamic, self-exchanging template that builds the working catalyst in operation. An anthraquinone-2-sulfonate (AQS)-intercalated NiFe-LDH film is grown on Ni foil, where the redox-active AQS stands upright as a π -stacked bilayer (~ 2.0 nm), and a mild $NaBH_4$ treatment condenses electron-withdrawing B-O-M-O linkages onto the surface. During oxygen evolution in 1 M KOH + 0.5 M NaCl, X-ray diffraction reveals a structural cascade ($2.0 \rightarrow 0.86 \rightarrow 0.79$ nm) in which the organic template is expelled and replaced by electrolyte chloride, so the catalyst reconstructs its own interlayer in situ. Time-resolved Raman identifies surface-reconstructed γ -NiOOH as the active phase, and ICP-MS confirms roughly halved Fe leaching. A Fe-free $Ni(OH)_2$ control establishes that the durability originates from boron-assisted retention of the Fe-O framework, which is anchored by the surrounding $Ni(OH)_2$ lattice during the OER. Although the activity gain is modest, the boron-modified film sustains 200 $mA\ cm^{-2}$ for ~ 87 h versus ~ 13 h untreated, recasting boron's role from raising Ni valence to retaining Fe.

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Separating extracellular miRNA sources using nanowire thermofluidics for tumor-associated function identification

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MicroRNAs (miRNAs) play a crucial role in tumor regulation, including oncogenesis [1]. For this reason, they serve as noninvasive biomarkers for cancer diagnosis and prognosis. However, standard extraction methods only isolate bulk miRNA from biological samples, making it difficult to determine whether the miRNA comes from an extracellular vesicle (EV)-free or EV-associated source [2]. Although common techniques can isolate both vesicles and free molecules, they only yield bulk data, meaning the precise source of the miRNA cannot be identified in one sample. In this study, we developed a zinc oxide nanowire thermofluidic device integrated with a temperature controller to capture and separate EV-free miRNAs and EV miRNAs from a single sample. Our results demonstrated the effectiveness of nanowire thermofluidics in capturing EVs and miRNAs using a small 50 μ L sample volume in 35 minutes. Additionally, we investigated interactions between nanowires and EVs or miRNAs, verifying hydrogen bonding as the primary interaction mechanism. To validate our approach, we applied nanowire thermofluidics to ovarian cancer serum samples, successfully separating and collecting the EV-free and EV miRNA populations. Subsequent analysis of the separated miRNAs showed a clear connection between their functions and their sources. Specifically, oncogenic miRNAs (such as miR-21) were found to reside within EVs [3], while tumor-suppressor miRNAs (such as the let-7 family) were located outside EVs [4]. In summary, our nanowire thermofluidics demonstrated its ability to capture and separate EV-free miRNAs and EV miRNAs from clinical biofluids. This work supports the development of precise and accurate diagnostic tools, enabling more effective cancer detection and clinical patient care.

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RSC-JAIMA Symposium 2026, Makuhari Messe, Chiba, Japan, September 3-4, 2026.

Development of Fluorescent Boronic Acid Probe for Biofilm Detection

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Abstract Biofilms, which consist of bacteria and extracellular matrix attached to materials and foods, spoil the surfaces and interfaces of materials and foods, and are resistant to antibiotics due to the protective effect of the matrix, which is mainly composed of polysaccharide polymers, and are therefore a cause of microbial contamination and disease. Therefore, the development of a simple and highly sensitive biofilm identification method that can detect biofilm formation at an early stage is desired. In this study, we aimed to detect biofilms using a fluorescent method, focusing on polysaccharides, a component of the extracellular matrix. In this presentation, we design a naphthaleneboronic acid probe that can detect biofilms, and report the results of evaluating its function. Synthesis of B-Nap-cb and B-Nap-cb/PEI: 6-hydroxy-2-naphthaleneboronic acid was pinacol-protected, reacted with methyl bromoacetate, and then deprotected to synthesize B-Nap-cb. This was condensed with polyethyleneimine (PEI) to synthesize B-Nap-cb/PEI. The modification of B-Nap-cb was confirmed by UV-vis measurement, and it was found that approximately 10% of the total amino groups of PEI were modified.

Results and Discussion i) Evaluation of the sugar recognition function of B-Nap-cb and B-Nap-cb/PEI: The pH dependence of B-Nap-cb and B-Nap-cb/PEI in the presence of fructose, glucose, and galactose was examined, and it was found that they recognized sugars and emitted light under basic conditions. ii) Biofilm detection by B-Nap-cb and B-Nap-cb/PEI: Biofilms of *Staphylococcus aureus* (*S. aureus*) and *Escherichia coli* (*E. coli*) were formed in a 96-well plate, and fluorescence was measured under basic conditions using B-Nap-cb and B-Nap-cb/PEI. The biofilm detection function was evaluated by calculating the ratio of the obtained fluorescence intensity to the fluorescence intensity of the probe alone. As a result, the fluorescence intensity ratio of B-Nap-cb/PEI was higher than that of B-Nap-cb for biofilms derived from both bacteria. It was suggested that the modification of B-Nap-cb to PEI led to multi-point recognition between the phenylboronic acid of B-Nap-cb/PEI and polysaccharides.

RSC-JAIMA Symposium 2026, Makuhari Messe, Chiba, Japan, September 3-4, 2026.

Development of a Silica-Enhanced Multiplex Colorimetric PAD for Wastewater Monitoring

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Abstract Food industry wastewater contains various pollutants that can negatively affect environmental quality and aquatic ecosystems. Therefore, rapid, simple, and portable analytical methods are required for environmental monitoring. Conventional laboratory-based analytical methods generally require complex procedures and expensive instrumentation, making them unsuitable for on-site applications [1]. Paper-based analytical devices (PADs) have been widely developed because of their low cost, ease of use, and portability [2]. However, the development of multiplex PAD systems specifically designed for rapid monitoring of food industry wastewater remains limited. This study aims to develop a multiplex colorimetric PAD for the simultaneous detection of pH, fats and oils, nitrate, and phosphate in food industry wastewater. The multiplex PAD was fabricated by dispersing PackTest reagents and silica powder in distilled water, followed by deposition onto the detection zones of a paper substrate and drying prior to use. The PAD was then directly immersed in the wastewater sample, and the resulting color changes were evaluated using a color chart. The developed multiplex PAD successfully generated distinguishable color responses for all target analytes: pH (5–9), fats and oils (0–50 mg/L), nitrate (0–50 mg/L), and phosphate (0–100 mg/L). The incorporation of silica powder enhanced color intensity and accelerated color development compared with the unmodified PAD. This improvement is attributed to the porous structure and high surface area of silica, which promotes efficient analyte diffusion and reagent retention, resulting in enhanced analyte–reagent interactions and stronger color development [3]. RGB image analysis demonstrated good analytical performance based on response linearity and coefficient of determination (R^2). The developed PAD exhibited rapid response, simple operation, and good analytical performance, demonstrating its potential as a portable platform for rapid on-site monitoring of food industry wastewater.



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Precise Controls over Metallic Core-Shell Nanoarchitectures with 2–8 nm Shell Thickness in a Pseudosolid Phase

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Abstract Conventional procedures for fabricating bimetallic core-shell nanoarchitectures typically involve precursors, reductants, and protecting agent in aqueous solution to ensure complete reaction, operational convenience, and well homogeneity. The protecting agent is essential, as it moderates the reaction rate and prevents aggregation during nanoshell formation. However, selecting appropriate protecting agent remains challenging, and precisely modulating shell thickness on the core surface is always sophisticated with tedious procedures. To address aforementioned obstacles, we employed a hydrogel-based pseudosolid medium as an alternative environment for metallic nanoarchitecture growth. In current work, polyacrylamide acts as a hydrophilic scaffold, creating a confined spatial environment and limited localized regions. The polyacrylamide density determines the polymer matrix complexity, which in turn dictates precursor mobility and the particle growth kinetics. Relying on the mobility-limited environment, the nanolayer thickness can be precisely manipulated to generate stable bimetallic core-shell nanostructures within hydrogel. These nanoarchitectures serve as heterogeneous catalysts for nitroaromatic reduction, facilitating a clearer understanding of the relationship between various substituted nitroaromatic molecules and the nanocatalyst surface. This straightforward strategy ensures uniform particle distribution, offers precise control over shell thickness, and provides a reliable platform for investigating catalytic performance. The platform not only enables a systematic study of structure-activity relationships and adsorption behaviors but also delivers a robust and reproducible strategy for the design of advanced core-shell nanocatalysts.

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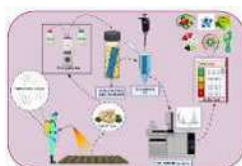
Development of a MOF-199/PDMS paper-based disposable microextraction device for rapid detection of pesticides from dry fruit.

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Abstract: The persistence occurrence of organochlorine pesticides (OCPs) found in dry fruits led to serious environmental and health risks because of their toxicity and bioaccumulation. In order to guarantee food safety, there is a need for an efficient and rapid analytical tool for monitoring and detecting the OCP residues from the dry fruit matrices. In this study a thin-film solid phase microextraction (TF-SPME) patch was fabricated using the synthesized metal-organic framework (MOF-199) which was incorporated with polydimethylsiloxane (PDMS) for the extraction of OCPs from the cashew samples. The developed TF-SPME patch's performance was evaluated by optimizing the various parameters. The optimized TF-SPME patch exhibited high extraction efficiency and good reproducibility for OCPs followed by the quantification using gas chromatography-mass spectrometry (GC-MS). The fabricated patch showed excellent sensitivity, indicating its potential as a simple, cost-effective and environmentally friendly analytical tool for the detection of the trace-level OCPs in cashew samples. This work highlights the feasibility of MOF-199 coated microextraction patch as a simple sample preparation tool for extraction of pesticide residues from dry fruit.(1–3)



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RSC-JAIMA Symposium 2026, MakuHari Messe, Chiba, Japan, September 3-4, 2026.

Development of Oxygen Sensor Integrated Micro Intestinal Model with a Controlled Oxygen Gradient

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The human small intestine possesses a physiological oxygen gradient, with an oxygen rich vascular region and a hypoxic luminal environment that supports the growth of anaerobic gut microbiota. Reproducing this oxygen microenvironment in vitro is essential for developing physiologically relevant micro intestinal models for drug absorption studies and host-microbiome interaction research. In this study, an oxygen sensor integrated micro intestinal model with a controlled oxygen gradient was developed.

An optical oxygen sensor film was fabricated by dispersing platinum(II)meso-tetra(pentafluorophenyl)porphyrin (PtTFPP) in polydimethylsiloxane(PDMS). The sensor film was integrated into a microfluidic intestinal device to enable noninvasive, real time monitoring of dissolved oxygen. A stable oxygen gradient was established between the epithelial and vascular channels by controlling oxygen transport within the device, reproducing the physiological oxygen environment of the human intestine.

The oxygen distribution was evaluated using luminescence quenching of PtTFPP, demonstrating that the integrated sensor enabled continuous monitoring of oxygen concentration while maintaining the controlled oxygen gradient. The developed platform provides a useful tool for investigating oxygen dependent intestinal physiology and is expected to facilitate long term co-culture of intestinal epithelial cells and anaerobic microorganisms. This micro intestinal model has potential applications in drug permeability evaluation, disease modeling, and studies of host-microbiome interactions.

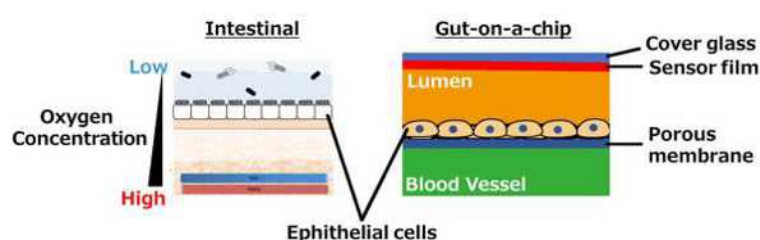


Figure 1. Schematic of the Micro Intestinal Model Integrated with an Oxygen Sensor

RSC-JAIMA Symposium 2026, MakuHari Messe, Chiba, Japan, September 3-4, 2026.

Paper-Based Analytical Device for Quantitative Detection of Salivary MMP-8 Toward Periodontal Disease Diagnosis

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[Background] Periodontal disease often presents few noticeable symptoms in its early stages, making regular dental check-ups crucial for early detection [1]. Consequently, matrix metalloproteinase-8 (MMP-8), which is involved in collagen degradation in periodontal tissues, has recently attracted attention as a biomarker for periodontal disease. To date, methods including lateral flow immunoassays and electrochemical sensors [2] have been reported for its detection. However, as these methods rely on antibodies, they present challenges in terms of cost and storage stability. Furthermore, it is difficult to directly assess the enzymatic activity of MMP-8 itself. Therefore, we developed an antibody-free device for detecting MMP-8 activity using collagen as a substrate.

[Concept] The device structure is shown in Fig. 1. Dye-modified collagen is used as enzyme substrate, enabling direct enzyme activity detection by visualizing dye release following collagen cleavage by MMP-8. Collagen was modified with either Remazol Brilliant Blue R (RBBR) or fluorescein-4-isothiocyanate (FITC-I).

[Results] In the colorimetric device, sensitivity was significantly improved by introducing the cationic polymer polyallylamine hydrochloride (PAH). Furthermore, the introduction of a spacer pad to regulate the liquid flow rate in the paper device significantly improved the reproducibility of the assay. With the fluorescence-based device, we addressed the sensitivity issues encountered in colorimetric detection, achieving an approximately 45-fold improvement in the detection limit. Finally, similar results were obtained in both artificial and real saliva, confirming that the device functions effectively even in real-sample conditions (Fig. 2).

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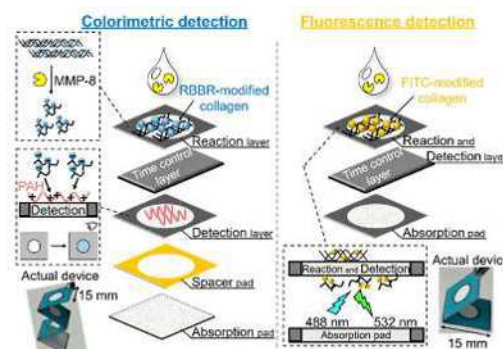


Fig. 1 Concept of MMP-8 detection and device design

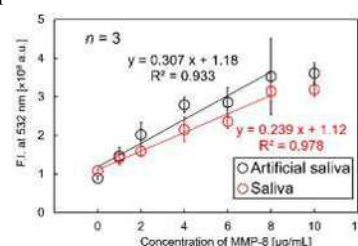


Fig. 2 Concentration response to MMP-8 in saliva

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Development of a Hydrothermal Decomposition Pretreatment for the Determination of Polycarbonate by HPLC with Electrochemical Detection

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[Introduction] Microplastics (MPs) are ubiquitously found in environmental media such as soil and air and have recently attracted considerable attention because of their potential impacts on human health and ecosystems. Among engineering plastics, polycarbonate (PC) is one of the fastest-growing materials in terms of production volume, highlighting the need for an analytical method capable of identifying and quantifying the dispersion of PC in the environment. Hydrothermal decomposition is a pretreatment method that uses only water under high-temperature and high-pressure conditions to decompose polymers. Because any organic solvents are not required, this approach offers a high level of operational safety and is expected to enable both qualitative and quantitative analyses while suppressing side reactions. In this study, we investigated a method for the determination of PC by combining hydrothermal decomposition pretreatment with HPLC coupled with electrochemical detection (HPLC-ECD).

[Methods] Finely ground PC powder was placed in a 24-cm quartz tube, and 282 μL of ultrapure water was added. After argon purging, the tube was heated in an electric furnace to induce hydrothermal decomposition. Then, the mixture was centrifuged, and the supernatant was analyzed by HPLC-ECD. The mobile phase was prepared by mixing an aqueous solution containing 0.1 M phosphate buffer (pH 2) and 0.125 M KCl with acetonitrile to give a final acetonitrile concentration of 18% (w/v). Separation was performed on a Unison UK-C18 column (100 $\times$ 1 mm) at a flow rate of 0.08 mL/min. A flow cell equipped with a track-etched membrane filter electrode was used for the detection [1], and the working electrode potential was set at 1.0 V vs. Ag/AgCl.

[Results] Hydrothermal decomposition of PC produced a peak with the same retention time as that of a phenol standard in the HPLC analysis, and ^{13}C NMR analysis confirmed that phenol was the major decomposition product. When 7.4 mg of PC was used, the phenol yield reached a maximum at a decomposition temperature of 400 $^{\circ}\text{C}$ and a reaction time of 360 min. Under this condition, quantitative analysis using phenol as an indicator was possible over the PC range of 0.28–7.4 mg. In contrast, when the amount of PC was 6.3 μg , only 0.2 ng of phenol was produced, indicating a marked decrease in phenol formation at trace PC levels. This decrease was likely attributable to the further decomposition of phenol into compounds such as benzene during the hydrothermal process. These results suggest that, for the application of hydrothermal decomposition to the quantitative analysis of trace amounts of PC, it is essential to establish reaction conditions that maximize phenol formation from PC while minimizing the subsequent decomposition of phenol are essential.

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Effect of Perfusion on Lipid Accumulation in a Microfluidic Renal Tubule Model Mimicking Diabetic Nephropathy-Associated Lipid Metabolic Dysfunction

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Chronic kidney disease (CKD) affects approximately 14.8 million people in Japan, and diabetic nephropathy is one of its leading causes. Although animal models are widely used in diabetic nephropathy research, the development of alternative human cell-based models is needed due to interspecies differences and concerns regarding animal welfare. In this study, we aimed to develop a physiologically relevant microfluidic renal tubule model that can be applied to drug screening by reproducing tubular injury associated with diabetic nephropathy.

To mimic the architecture of the renal tubule and surrounding peritubular capillaries, a microfluidic device was designed with two parallel microchannels representing the vascular and tubular luminal compartments, separated by a porous membrane (Fig.1). The device was fabricated from polydimethylsiloxane (PDMS) with a porous polyethylene terephthalate (PET) membrane that served as an artificial basement membrane. Human glomerular endothelial cells (GEnC) and human proximal tubular epithelial cells (RPTEC/TERT1) were cultured on the upper and lower surfaces of the membrane, respectively. Physiological shear stress was reproduced by applying continuous medium perfusion. To model the lipid metabolic dysfunction characteristic of diabetic nephropathy, the co-cultured cells were exposed to a palmitic acid–bovine serum albumin (PA-BSA) complex. Lipid accumulation was assessed by Lipi-Red staining, and oxidative stress was evaluated by measuring reactive oxygen species (ROS). In addition, perfusion and static culture conditions were compared to investigating the effects of fluid flow on lipid metabolic dysfunction and cellular injury.

By incorporating co-culture and physiological shear stress, this model recapitulates key aspects of the *in vivo* renal tubular microenvironment. Therefore, it has the potential to serve as a valuable platform for investigating the pathophysiology of diabetic nephropathy and for the evaluation and development of novel therapeutic agents.

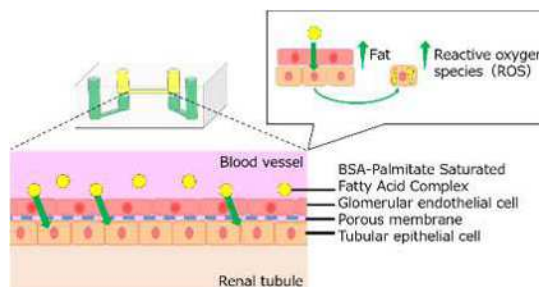


Fig.1: Diagram of a microfluidic renal tubule model simulating lipid metabolic dysfunction

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Quantitative evaluation of Shodoamide C as the potentiator of membrane pore formation using the microfluidic liposome array

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Pore formation in lipid membranes surrounding cells enhances membrane permeability, which can facilitate intracellular material delivery and cell death induction. Therefore, quantitative evaluation of pore-forming agents is important. Shodoamide C (ShC) [1] enhances the antifungal activity of amphotericin B (AmB), which forms pores in lipid membranes. However, this enhancing effect has been confirmed only by inhibition of fungal growth, and its mechanism remains unclear. We previously developed an analytical system in which liposomes were formed and arrayed using a microfluidic device, and membrane pore formation in lipid membranes was quantitatively evaluated based on the leakage of encapsulated molecules[2]. In this study, we used the analytical system to evaluate the dependence of pore formation in the lipid membrane on the concentration of ShC. The microfluidic device was fabricated using soft lithography. Liposomes were formed by sequentially introducing an inner aqueous phase containing calcein, an oil phase containing lipids and ergosterol, and an outer aqueous phase within a microchannel. The resulting liposome suspension was introduced into a device with trapping structures to form a liposome array. A mixed solution of AmB and ShC was used for membrane pore formation analysis. The concentration of AmB was fixed at 12.5 μM , and the concentration of ShC was varied from 0 to 1250 μM . Changes in fluorescence intensity were monitored to evaluate the release of encapsulated calcein from the liposomes. A time-course profile of this change was obtained, and a slope value of the speed of calcein release was used as an index for quantitative evaluation of membrane pore formation. Liposomes were successfully formed and arrayed using the microfluidic device, and the coefficient of variation of the liposome diameter was 4 %. The slope values obtained for liposomes exposed to both AmB and ShC were significantly lower than those obtained for liposomes exposed to AmB or ShC individually. This result was derived from the cooperative effect of ShC and AmB on membrane permeability. The effect of ShC concentration on membrane pore formation was then evaluated while maintaining the AmB concentration at 12.5 μM . At ShC concentrations of 0–50 μM , the slope values were similar to those obtained with AmB alone. In contrast, the slope value markedly decreased at 1250 μM ShC. At intermediate ShC concentrations of 100–400 μM , the slope values were between those observed for AmB alone and 1250 μM ShC, and no clear concentration-dependent change was observed within this range. These results suggest that pore formation by AmB alone and pore formation involving complexes with ShC may occur simultaneously under these conditions. This method is expected to provide new insights into pore formation in lipid membranes and to be further developed as a high-throughput analytical system for pore-forming agents and enhancers of antifungal activity.

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Acknowledgements: We thank Prof. Taro Toyota (The University of Tokyo) for his support in microfabrication.

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Barcode-Based Paper Analytical Device for Point of Care Testing

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Introduction Paper-based analytical devices (PADs) have attracted considerable attention for point-of-care testing (POCT) because of their low cost, portability, and ease of use. However, most PADs rely on visual interpretation of color changes, which can lead to user-dependent result evaluation and difficulties in digital data management. To address these limitations, a barcode-based PAD was developed in this study that converts analytical results into barcode signals, enabling user-independent result readout and digital management of analytical data.

Experimental Chloride detection was demonstrated using a distance-based PAD. The device was simply dipped into the sample to induce a chloride concentration-dependent color change distance via a previously reported precipitation-based colorimetric reaction [1]. After 7 min, the generated barcode was scanned using a smartphone. The detection principle employed in this study was based on barcode signal changes from “MMMMM” to “/////” using the Code39 barcode system reported in our previous work [2]. As the chloride concentration increased, the barcode signal gradually changed from “MMMMM” to “/////”, enabling chloride detection at six levels (Fig. 1).

Results The developed device successfully enabled six-level chloride detection in aqueous samples. Furthermore, barcode readout was unaffected by dipping time, smartphone type, or user operation. The device also showed high selectivity toward chloride without interference from major urinary constituents. Finally, the developed device successfully detected chloride in 10 human urine samples, and the results showed good agreement with those obtained using an ion-selective electrode (ISE) method. These results demonstrate the applicability of the developed barcode-based device to practical POCT applications.

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- [2] Y. Manmana, S. Kinugasa, Y. Hiruta, D. Citterio, *Anal. Chem.*, **97** (3), 1500–1506 (2025).

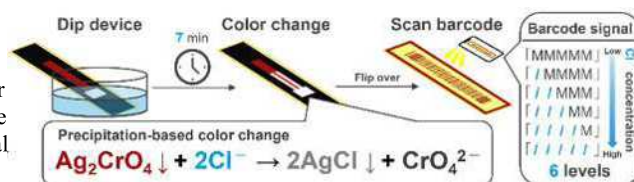


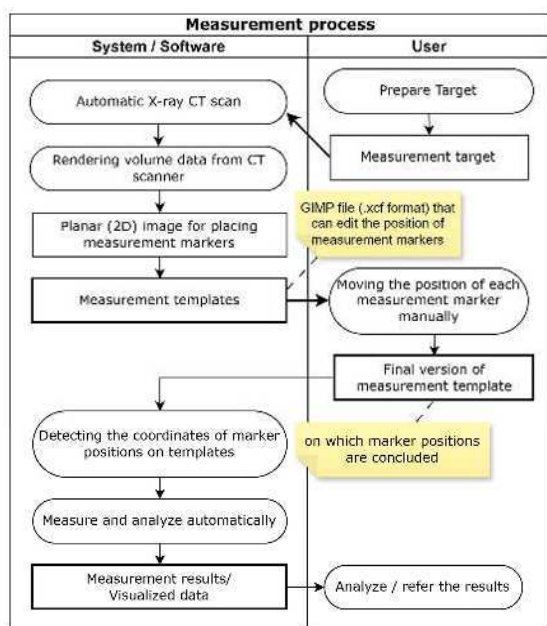
Fig. 1 Assay workflow and detection mechanism

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Measurement-Template Workflow for Human-in-the-Loop Quantification in 2D/3D Imaging-Based Research

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¹ Nihon Visual Science, Inc.



Abstract A measurement template is a layered image file containing multiple movable measurement markers superimposed on target imagery. By positioning these markers over key features in the object being measured, you establish the necessary coordinate data for various measurements. The actual measurement process is performed using application-specific tools designed for both measuring and plotting, which accept the measurement template and its accompanying data as inputs. This system employs a collaborative, semi-automated approach where both the generation and processing of measurement templates are automated, while the definition of measurement points and their placement remains manually performed by experts. The key advantage lies in enabling high-volume production of accurate measurements based on expert knowledge with minimal manual effort.[1] Furthermore, by utilizing 3D rendered images as target imagery, this system can also convert measurement markers placed upon these images into spatial coordinates through correspondence with 3D data. This allows for three-dimensional measurements including volume calculation, capacity determination, and definition of reference planes.[2]

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Green-Synthesized TiO₂ Nanoparticles from *Annona muricata* Peel Extract: Comparative Physicochemical Characterization and Preliminary Photocatalytic Evaluation Against Paracetamol

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Abstract

Paracetamol (PCT) is a widely consumed analgesic classified as an emerging pharmaceutical micropollutant due to its persistence in aquatic environments and resistance to conventional wastewater treatment; TiO₂-based photocatalytic advanced oxidation processes offer a promising remediation route, and green synthesis via plant extracts provides a sustainable alternative to hazardous chemical methods, yet the influence of extraction solvent polarity on nanoparticle properties and photocatalytic performance remains insufficiently explored for tropical bioresources such as *Annona muricata* peel. This study synthesized TiO₂ nanoparticles via sol-gel using titanium(IV) isopropoxide mediated by aqueous (TiO₂-EA) and ethanolic (TiO₂-EE) extracts of *A. muricata* peel, characterized both samples by XRD, FTIR, UV-DRS Tauc plot, and FESEM-EDS, and evaluated preliminary photocatalytic activity against 15 mg/L PCT under UV-C irradiation ($\lambda = 254$ nm) for 180 min. Both samples yielded pure anatase-phase TiO₂ with similar primary crystallite sizes (8.6 nm vs. 9.9 nm); UV-DRS Tauc plot analysis revealed markedly different optical bandgap energies (3.21 eV for TiO₂-EA vs. 3.40 eV for TiO₂-EE), and FESEM confirmed agglomerated spherical morphology in both; in preliminary photocatalytic evaluation, TiO₂-EE achieved greater PCT removal efficiency than TiO₂-EA despite its wider optical bandgap, with both outperforming control TiO₂ and direct UV-C photolysis. This counter-intuitive result suggests that surface physicochemical properties conferred by ethanolic

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phytochemical capping agents are a more decisive determinant of photoactivity than bandgap energy alone, positioning *A. muricata* peel as a promising tropical bioresource for green TiO₂ synthesis.

Keywords: Green synthesis; TiO₂ nanoparticles; *Annona muricata*; paracetamol; photocatalysis; UV-DRS; bandgap energy; sol-gel; solvent polarity

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Development of a Chemically Modified PDMS Membrane for Stretch Cell Culture

Fuka Yamamoto, Kae Sato
Japan Women's University

1.Introduction

A cell stretching device with a PDMS membrane fabricated by a water-suspension method has been developed¹⁾. Because cells with weak adhesion to the PDMS membrane tend to detach during stretching stimulation, investigating cell culture substrate modification methods to improve cell adhesion is an important issue. In this study, the human oral squamous cell carcinoma cell line HSC4 was cultured statically on a PDMS membrane within the device, and the effects of different membrane modification methods on cell adhesion were compared. In addition, cells were cultured while under stretching stimulation using chemically modified devices, and the effects of stretching on cells were evaluated.

2.Experiment

Degassed MilliQ water was placed in a 30-mm-diameter polypropylene petri dish, and degassed uncured PDMS was dropped into the center of the water surface using a syringe. The PDMS was then heat-cured to form a membrane. The membrane was sandwiched between a lower sheet with a degassing chamber and an upper sheet with a culture channel, and degassing holes were punched through the assembled device. Cell loading tubes and degassing tubes were routed to complete the cell stretching device. The surfaces of the cell culture channels in the fabricated cell stretching device were modified, and the effects of these modifications on cell adhesion were investigated. Four surface modification conditions were compared: unmodified, 3-aminopropyltriethoxysilane (APTES)-modified, glutaraldehyde (GA)-modified, and (3-triethoxysilyl)propyl succinic anhydride (TESPSA)-modified. Cells were seeded onto the GA-modified device and cultured for 20 hours under stretching stimulation. A Live/Dead assay and F-actin staining were performed.

3.Results

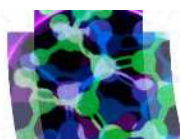
The GA-modified device showed the highest number of adherent cells per unit area 24 h after cell seeding. TESPSA modification yielded the second highest cell count after GA modification but showed poor reproducibility. When cells were cultured under stretching stimulation using the GA-modified device, no cell detachment was observed, and adhesion was maintained throughout the stretching period. Furthermore, no significant differences were observed in viability or cell morphology compared with cells cultured without stretching stimulation. Reproducibility is currently being evaluated.

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RSC-JAIMA Symposium 2026, Makuhari Messe, Chiba, Japan, September 3-4, 2026.

RSC-JAIMA Symposium on Analytical Chemistry 2026: Computational Techniques in Analytical Chemistry

3-4 September 2026 | Chiba, Japan



Makuhari Messe, Chiba-city, Japan (International Conference Hall / 2F International Conference Room)

Organized by the Royal Society of Chemistry (RSC) in affiliation with the Japan Analytical Instruments Manufacturers' Association (JAIMA)

Admission: **Free (pre-registration required)** Language: **English**

3-Sep-26

Coordinators: Daniel Citterio and Hideaki Hisamoto

Time	Event
9:00-9:30	
9:30-9:40	Opening Remarks <i>Hideaki Hisamoto, Osaka Metropolitan University</i> <i>Hisashi Sugisawa, Japan Analytical Instruments Manufacturers' Association (JAIMA)</i>
9:40-10:25	Flash Presentation 1 Presenters
10:25-11:05	Chairperson : Hideaki Hisamoto Plenary Talk (40 min), Infrared spectral pathology. Are we closer to clinical adoption? Peter Gardner, University of Manchester
11:05-12:05	Poster Session 1 Presenters
12:05-14:05	Lunch Break & Exhibition
14:05-14:50	Flash Presentation 2 Presenters
14:50-15:30	Chairperson : Hideaki Hisamoto Plenary Talk (40 min), Droplet confined colloidal assembly and applications Lingling Shui, South China Normal University
15:30-16:10	Chairperson : Kiichi Sato Plenary Talk (40 min), MOF Crystallography of Microgram-Scale Bioactive Molecules Masaki Kawano, Institute of Science Tokyo
16:10-17:10	Poster Session 2 Presenters

4-Sep-26

Coordinators: Daniel Citterio and Hideaki Hisamoto

Time	Event
9:30-10:15	Flash Presentation 3 Presenters
10:15-10:55	Chairperson : Daniel Citterio Plenary Talk (40 min), From data acquisition to knowledge generation: The transformative role of artificial intelligence in analytical chemistry Pai-Shan Chen, National Taiwan University
10:55-11:10	Break w/ audience rotation
11:10-11:50	Chairperson : Daniel Citterio Plenary Talk (40 min), Computational and machine learning approaches for the identification of unknown chemicals by mass spectrometry Han Bin Oh, Sogang University
11:50-13:30	Lunch Break & Exhibition
13:30-14:30	Poster Session 3 Presenters
14:30-15:00	Chairperson : Akihito Hibara Invited Talk (30 min), Data-Driven Design of 2D Materials for Electrochemical Applications Pawin lamprasertkun, Thammasat University
15:00-15:15	Break w/ audience rotation
15:15-15:35	Chairperson : Akihito Hibara RSC lecture (20 min), Publishing for Impact <i>Zhanhao Hu, Royal Society of Chemistry</i>
15:35-15:50	Break w/ audience rotation
15:50-16:30	Award Ceremony & Closing <i>Daniel Citterio, Keio University</i>

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Kazuki Ito (Japan Analytical Instruments Manufacturers' Association)

Kenji Ito (Japan Analytical Instruments Manufacturers' Association)

Closing Remarks

It is our great pleasure to organize the RSC-JAIMA Symposium on Analytical Chemistry (RSC-JAIMA) 2026 “*Computational Techniques in Analytical Chemistry*” supported by The Royal Society of Chemistry (RSC) and Japan Analytical Instruments Manufacturer’s Association (JAIMA). This event has been held as the RSC Tokyo International Conference (RSC-TIC) since 2011. The theme “Computational Techniques in Analytical Chemistry” was selected to highlight the growing importance of integrating computational approaches with experimental techniques and their potential to open new avenues for the future of analytical chemistry.

RSC-JAIMA2026 was composed of plenary and invited talks, and flash presentation & poster sessions related with various analytical chemistry and instrumentation. We accepted 100 poster presentations including 14% from industry, and 86% from academic institutions. Notably, 31% of the presentation are from the countries other than Japan. Thus, discussion from various viewpoints of fundamental science, industrial applications, and instrumentation are expected to be held.

When the former RSC-TIC was launched, “flash presentation & poster session” was specially planned to provide an opportunity to discuss various analytical topics among many analytical chemists involving industrial and academic researchers. Especially, we expected an attendance of young researchers who will become leaders in the next generation. “Flash presentation” means a short (60 seconds) introduction on the presenter’s “poster presentation”. All the participants can understand the summary of various research topics within a limited time, which is expected to encourage fruitful discussion at the following poster session. In addition, “flash presentation” may help all the participants to know researcher’s “face” each other, and then, the participants easily find interesting presentations. This system has been working quite successfully since it started.

Since the RSC-JAIMA is held beside Japan Analytical and Scientific Instruments Show (JASIS), this conference can be considered as one of the best opportunities to exchange information between industrial and academic researchers, and such opportunity is hardly held in other general conferences in Japan.

In closing, we expect all the participants to establish cooperative relationships in RSC-JAIMA to proceed research collaborations, and we believe that such collaboration will open the new analytical science and technology involving the development of new principles and instrumentations, and will accelerate industrial-academic cooperation.

September 4th, 2026

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