Electrochemistry
The Electrochemical Society of Japan
Received: May 22, 2025
Accepted: May 25, 2025
Published online: June 14, 2025
Issued: June 14, 2025
https://doi.org/10.5796/electrochemistry.25-71086
Editorial
Electrochemistry, **93(6)**, 062001 (2025)

The 71st special feature "New Progress of Batteries and Fuel Cells"

Preface for the 71st Special Feature "New Progress of Batteries and Fuel Cells" — Getting Off to a Fast Restart

Nobuyuki IMANISHI,[a,*,§] Daisuke MORI,[a,§§] Hikari SAKAEBE,[b,§] Masaki MATSUI,[c,d,§§] Tomokazu FUKUTSUKA,[e,§§] Toshihiko MANDAI,[f,§§] and Kohei MIYAZAKI[g,§§]

[a] *Division of Applied Chemistry, Graduate School of Engineering, Mie University, 1577 Kurimamachiyacho, Tsu, Mie 514-8507, Japan*
[b] *Institutefor Materials Chemistry and Engineering, Kyushu University, 6-1 Kasuga-koen, Kasuga, Fukuoka 816-8580, Japan*
[c] *Graduate School of Chemical Sciences and Engineering, Hokkaido University, Kita 13, Nishi 8, Kita-ku, Sapporo, 060-8628, Japan*
[d] *Department of Chemistry, Faculty of Science, Hokkaido University, Kita 10, Nishi 8, Kita-ku, Sapporo, 060-0810, Japan*
[e] *Graduate School of Engineering, Nagoya University, Furo-cho, Chikusa-ku, Nagoya 464-8603, Japan*
[f] *Research Center for Energy and Environmental Materials, National Institute for Materials Science, 1-1 Namiki, Tsukuba, Ibaraki 305-0044, Japan*
[g] *Department of Chemical Science and Engineering, Graduate School of Engineering, Kobe University, 1-1 Rokkodai-cho, Nada-ku, Kobe 657-8501, Japan*

* *Corresponding author: imanishi@chem.mie-u.ac.jp*

ABSTRACT

This special issue of *Electrochemistry* features selected papers from the 65th Battery Symposium in Japan, held in November 2024, which marked a full return to in-person meetings after the COVID-19 pandemic. The symposium saw record participation, highlighting strong interest in lithium-ion batteries, all-solid-state batteries, and emerging chemistries such as sodium-ion and lithium–sulfur systems. Progress in electrolyte design, interfacial science, and data-driven approaches was also emphasized. Additionally, several contributions focused on fuel cell research, reflecting the expanding scope of electrochemical energy technologies. We hope this collection stimulates further innovation in energy storage and conversion.

© The Author(s) 2025. Published by ECSJ. This is an open access article distributed under the terms of the Creative Commons Attribution 4.0 License (CC BY, https://creativecommons.org/licenses/by/4.0/), which permits unrestricted reuse of the work in any medium provided the original work is properly cited. [DOI: 10.5796/electrochemistry.25-71086].

Keywords : The 65th Battery Symposium in Japan, Lithium-Ion Batteries, All-Solid-State Batteries, Fuel Cells

Welcome to this special feature on papers related to the 65th Battery Symposium in Japan held on November 20–22, 2024 in Kyoto. This feature, organized by the Committee of Battery Technology, highlights selected presentations from the symposium held last autumn. Symbolically, the 2024 symposium marked a revitalization following the disruptions caused by the COVID-19 pandemic. Due to the outbreak of the COVID-19 pandemic in early 2020, the Battery Symposium in Japan was held online for the first time that year. From 2021 onward, the symposium gradually transitioned to a hybrid format, and finally, the 65th symposium in 2024 marked a full return to in-person meetings after five years. This milestone was achieved under the leadership of Professor Takeshi Abe, who now serves as the Chair of the Committee of Battery Technology. The number of presentations and participants reached record highs—574 and 2998, respectively—reflecting the rapid recent growth of the battery industry.

In support of this momentum, the Committee of Battery Technology planned this special feature in *Electrochemistry* to further promote research and innovation in the field. To encourage submissions, the committee also offered APC (Article Processing Charge) support for contributing authors. An analysis of presentation trends at the 65th symposium revealed that the largest category was "LIBs" (Lithium-Ion Batteries), accounting for 40.3 % of all papers. The second largest was "All-Solid-State Batteries," at 22.6 %. Among subcategories, two topics stood out. The first —"Large-scale systems, safety, evaluation, fast charging, reuse, etc."—comprised 12.3 % of total presentations, a significant increase from the previous year and the highest among all subcategories. The second—"Multivalent Batteries and Novel Batteries"—represented 12.0 %, also showing notable growth. The first of these subcategories reflects the long-standing technological challenges faced by LIBs as they support and lead the expansion of the global electric vehicle (EV) market. Since fiscal year 2020, global EV sales have grown rapidly, surpassing 11 million units in FY2024. This dramatic growth demands continuous innovation—not only in extending driving range and shortening charging time, but also in the design, integration, and management of LIBs within EV systems. The prominence of this topic at the symposium reflects such global trends. In the "Multivalent and Novel Batteries" category, research included emerging systems such as sodium-ion batteries (a non-lithium alternative), as well as lithium–sulfur and lithium–oxygen batteries utilizing molecular materials as electrodes. Historically,

§ECSJ Fellow
§§ECSJ Active Member
N. Imanishi orcid.org/0000-0003-1424-0729
D. Mori orcid.org/0000-0002-1653-4555
H. Sakaebe orcid.org/0000-0002-2520-1621
M. Matsui orcid.org/0000-0003-1499-7457
T. Fukutsuka orcid.org/0000-0002-8731-9078
T. Mandai orcid.org/0000-0002-2403-7794
K. Miyazaki orcid.org/0000-0001-5177-3570

electrode reactions have evolved from dissolution–deposition mechanisms to intercalation-type systems, improving reaction reversibility and enabling the rise of modern mobility. Now, we are witnessing a shift beyond intercalation reactions, with electrode processes moving into a new era. This transition relies heavily on the development of advanced electrolytes and a deeper understanding of interfacial phenomena. Recent innovations in electrolyte design—including sulfide-based solid electrolytes, ionic liquids, highly concentrated electrolytes, and other non-conventional systems—are paving the way for novel approaches, such as aqueous battery systems.

Beyond materials research, other interdisciplinary developments are gaining momentum. Battery phenomena are increasingly analyzed and predicted through information science, while advanced materials are synthesized with the aid of robotics and automation. These emerging research directions—fast-moving and highly promising—were well-represented among the papers presented at the symposium, demonstrating the evolving landscape of battery research. The 65th Battery Symposium in Japan served as a vibrant forum for discussing many of these exciting ideas. We are pleased to present this special feature in collaboration with *Electrochemistry*.

In parallel with these advances in battery technologies, fuel cells are also evolving as a crucial component in the broader field of electrochemical energy conversion. At the 65th Battery Symposium in Japan, a number of presentations addressed topics in fuel cell research, highlighting progress in materials, catalyst design, and system integration. These developments reflect the expanding scope of electrochemical research beyond batteries, and this special feature includes several papers focusing on fuel cell technologies. Their inclusion underscores the Committee's commitment to fostering innovation across the entire landscape of energy storage and conversion.

This issue includes several invited review papers, two of which describe the current status of national battery-related projects in Japan, and one that explores the latest trends in LIBs for automotive applications. We hope you find these, along with the original research articles, engaging and informative. We sincerely hope that this special feature will further stimulate battery research and drive new innovations in the near future.

Acknowledgment

We would like to express our deep appreciation to Professor Minoru Mizuhata, Editor-in-Chief of *Electrochemistry*, for his dedicated support in planning and executing this feature. We also thank the editorial board for their thoughtful reviews and assistance. The editors' profiles are listed below.

The APC for the publication of this paper was supported by The Committee of Battery Technology, ECSJ.

CRediT Authorship Contribution Statement

Nobuyuki Imanishi: Project administration (Lead), Writing – original draft (Lead)
Daisuke Mori: Project administration (Supporting)
Hikari Sakaebe: Project administration (Supporting)
Masaki Matsui: Project administration (Supporting)
Tomokazu Fukutsuka: Project administration (Supporting)
Toshihiko Mandai: Project administration (Supporting)
Kohei Miyazaki: Project administration (Supporting)

Conflict of Interest

The authors declare no conflict of interest in the manuscript.



Nobuyuki Imanishi (Professor, Graduate School of Engineering, Mie University)

Nobuyuki Imanishi received his PhD from Kyoto University in 1993. He started his research professionally at 1990 in Mie University and after 22-year career as assistant and associate professor, he promoted to the current position at 2012. He served as Vice President and Deputy Executive Director (2023–2025), Executive Director (2021–2023) of Mie University. He specializes in functional ceramics and electrochemistry, with a particular focus on energy conversion and storage materials. His research includes the development of lithium battery materials utilizing soft matter. Recently, his work has centered on two key areas: lithium metal batteries and aqueous lithium-air batteries.



Daisuke Mori (Associate Professor, Graduate School of Engineering, Mie University)

Daisuke Mori received his Dr. Sci. from Tokyo Institute of Technology in 2006. He worked as a researcher at Tokyo Institute of Technology (2006–2007), National Institute of Advanced Industrial Science and Technology (AIST) (2007–2008), and then as a Research Fellow of the JSPS (2008–2009). Then he moved to Gakushuin University as an Assistant Professor (2008–2017). Currently, he is an Associate Professor at Mie University. His research interests focus on the electrode materials and solid electrolytes for high-energy batteries (all solid state, Li-metal, fluoride-shuttle, and so on).
Hobby: Kendo.



Hikari Sakaebe (Professor, Institute for Materials Chemistry and Engineering, Kyushu University)

Hikari Sakaebe received his Dr. Eng. from Kyoto University in 1996. She worked as a researcher, senior researcher, chief senior researcher (1991–2021), and Prime Senior Researcher (2022) at National Institute of Advanced Industrial Science and Technology (AIST), and then moved to Institute for Materials Chemistry and Engineering, Kyushu University as a Professor (2023– present). Her research interests focus on the development of the novel high energy battery systems (Li-sulfur, fluoride-shuttle, and so on) and materials for them.
Hobby: Music and hand craft.



Masaki Matsui (Professor, Department of Chemistry, Hokkaido University)

Masaki Matsui received Ph.D. in Engineering from Tokyo Metropolitan University in 2008. He worked at Toyota Motor Corporation and Toyota Research Institute of North America from 2001 to 2012. He started academic carrier in 2012 at Mie University, and his position changed to PREST researcher at JST in 2013, associate professor at Mie University in 2015. He moved to Kobe University as an associate professor in 2016. Then, he got the present position in 2021. His research interest is inorganic materials chemistry for beyond lithium-ion batteries. He got the committee of battery technology award in 2015.



Tomokazu Fukutsuka (Professor, Graduate School of Engineering, Nagoya University)

Tomokazu Fukutsuka is currently a professor at Graduate School of Nagoya University. He was a research associate at Himeji Institute of Technology (currently University of Hyogo) from 2000 to 2007. He earned Doctor of Engineering from Kyoto University in 2005. In 2007, he moved to Kyoto University as a research associate (Graduate School of Human and Environmental Studies) and was promoted to an associate professor in 2010 (Graduate School of Engineering). In 2018, he moved to Nagoya University as a full professor. He was awarded Young Researcher Award (Sano Award) from The Electrochemical Society of Japan in 2011. His research interests are energy conversion devices such as lithium-ion batteries and next-generation rechargeable batteries (all-solid-state Li, Na, Mg, and F).



Toshihiko Mandai (Team Leader, Research Center for Energy and Environmental Materials, NIMS)

Toshihiko Mandai received his PhD from Chiba University in 2012, and worked as a postdoc and an assistant professor in several universities. In 2019, he joined NIMS as a senior researcher and was promoted to principal researcher/Team leader in 2024. His research interests include coordination complex for electrolyte applications and interfacial chemistry in multivalent metal battery systems. Hobby: Cooking and swimming.



Kohei Miyazaki (Professor, Graduate School of Engineering, Kobe University)

Kohei Miyazaki received his Dr. Eng. from Kyoto University in 2008. He worked as an assistant professor (2008–2018) and an associate professor (2018–2025) at Graduate School of Engineering, Kyoto University, investing fuel cells and aqueous-electrolyte-based battery systems. He moved to Kobe University and is currently a professor at Graduate School of Engineering, Kobe University. His current research interests focus on water electrolysis (acid and alkaline), especially, electrocatalysts, and next-generation rechargeable batteries.