SPECIAL ISSUE

Advanced Characterizations for Energy Materials, Devices and Systems

Keywords: Characterization; spectroscopy; energy materials; energy conversion devices; energy system

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About this Special Issue

The rapid development of advanced energy technologies has created an increasing demand for a comprehensive and in-depth understanding of the structure, properties, and dynamic evolution of energy materials, devices, and systems. In practical operating environments, the performance and reliability of energy-related technologies are determined by complex physicochemical processes, including phase transitions, chemical reactions, charge and ion transport, interfacial interactions, structural reconstruction, degradation, and failure.

These processes often occur across multiple spatial and temporal scales, making their direct observation and mechanistic understanding particularly challenging. Advanced characterization technologies therefore play a critical role in uncovering the fundamental mechanisms governing the behavior and evolution of energy materials and devices under realistic operating conditions.

Aims & Scope

This Special Issue, entitled **“Advanced Characterizations for Energy Materials, Devices and Systems,”** aims to highlight recent advances in characterization methodologies and their applications in emerging energy technologies. Contributions are particularly encouraged to address the development of advanced characterization techniques, in situ/operando investigations, multiscale and multimodal characterization, and mechanistic studies of energy materials, interfaces, devices, and systems.

We welcome both fundamental and application-oriented studies that employ advanced characterization to elucidate structure-property-performance relationships, reveal degradation and failure mechanisms, and provide new insights for the rational design and optimization of next-generation energy technologies.

RESEARCH FOCUS

Characterization Across Materials, Devices & Systems

The collection is designed to connect advanced measurement science with practical questions in energy conversion, storage, interfaces, device reliability and system performance.

Suggested Areas

- Advanced spectroscopy, microscopy, diffraction and complementary characterization methodologies for energy research.
- In situ and operando investigations that reveal dynamic structural, chemical and interfacial evolution under realistic working conditions.
- Multiscale and multimodal characterization integrating information across spatial, temporal and chemical dimensions.
- Mechanistic studies of phase transitions, chemical reactions, charge transport, ion transport and interfacial interactions.

Mechanistic & Applied Studies

- Characterization of structural reconstruction, degradation, aging, reliability and failure mechanisms in energy materials and devices.
- Studies establishing structure-property-performance relationships to guide rational materials and device optimization.
- Application-oriented characterization of emerging energy conversion devices, materials and integrated energy systems.

Guest Editors

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Invitation to Contribute

Researchers working on advanced characterization and emerging energy technologies are invited to contribute studies that deepen mechanistic understanding and support the design and optimization of next-generation energy materials, devices and systems.

Article categories, submission deadlines, publication dates and journal-specific submission instructions can be added once finalized.