Energy LAB

EDITORIAL

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Laboratory innovations for sustainable energy technologies and science

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Current energy technologies associated with fossil fuels, including coal, natural gas, and petroleum, have been vitally supporting the world's industrialization, which sustains economic growth and productivity in all countries. However, the sustainability of fossil energy and the significant negative impact on climate change have become essential concerns worldwide. Exploring innovative concepts and approaches to change our traditional energy production and usage is urgent to address energy and environmental sustainability issues.

The near-term solutions are to increase energy efficiency and utilization of currently commercialized technologies through existing carbon-based fuels and dramatically mitigate CO_2 and other pollutant emissions via effective carbon capture, storage, and conversion.

On the contrary, the long-term strategies rely on the development of clean and carbon-free clean energy technologies, such as renewable energy (solar, wind, biofuels) and advanced energy storage and conversion (batteries, fuel cells, photosynthesis). In particular, efficient energy production, conversion, and utilization via clean electrochemical energy technologies coupled with renewable energy sources have been identified as one of the most feasible and sustainable solutions.

Among others, advanced batteries with sufficient energy density, cyclic stability, fast charging capability, and safety are highly desirable to realize transportation electrification, which is critical to minimizing CO_2 emission and mitigating climate change. Also, clean and sustainable chemical productions *via* electrosynthesis have attracted ever-increasing attention by utilizing renewable electricity. Importantly, hydrogen energy technologies have been launched recently. The basic concept is that water electrolyzers can utilize "off-peak" electricity from renewable sources such as solar or wind farms to produce hydrogen, which can subsequently be operated in a fuel cell mode to generate electricity or used as intermediates for other industrial applications. Alternative to electrolyzers, advanced photoelectrochemical (PEC) water-splitting cells are attractive to produce clean hydrogen from sunlight directly. Thus, compared to conventional batteries, the chemical storage of renewable energy in the form of hydrogen has the advantages of high energy density, long duration, and more flexibility. Notably, carbon-free nitrogen electrochemistry could play an important role in realizing efficient renewable energy storage and conversion associated with essential nitrogen-containing compounds such as nitrogen gas, ammonia, and nitrate.

However, current clean energy technologies are still in the early stage facing grand challenges related to low efficiency, insufficient durability, high cost due to the use of precious metals, and scalability. To solve these vital energy problems, laboratory research is essential to advancing the fundamental understanding, developing critical materials, seeking new solutions, building functional prototype devices, and further pursuing technology transfer from laboratory to market.

In response to the evident and urgent needs, *Energy Lab* is a leading and interdisciplinary new journal that is a unique platform to publish and disseminate significant experimental and theoretical advances in all these energy areas. Supported by high-profile international editorial and advisory boards, *Energy Lab* welcomes contributions that range from advanced materials, theory, and catalysis, to technology development and economics in the field of photovoltaics, solar cells, artificial photosynthesis, biofuels, CO_2 conversion and utilization, batteries, electrolyzers, fuel cells, and other hydrogen production, storage, and utilization. In addition to original research papers, perspectives, reviews and comments from leading researchers on newly emerging topics will also be a key part of the journal.

Critical laboratory research to discover and create innovations for subsequent transitioning to scalable and sustainable energy technologies is crucial for rapidly addressing global energy and environmental sustainability issues and problems, which is the primary and exceptional feature of *Energy Lab*.

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