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# Editorial: Small-Structure Innovation of Catalysis Powers a Sustainable Future

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To tackle the grand twin challenges of sustainable energy supply and climate change, *Small Structures* of the advanced catalysts can play a central role in not only promoting the energy conversion such as green hydrogen production and energy storage, but also mitigating green-house gas threats for value-added fuel conversion. Catalysis, one of the most active and diversified research fields, is pivotal to achieving the zero-emission target in the coming decades. The significant advancements have been witnessed in material design, experimental technology, and fundamental knowledge. To document the state-of-the-art of these advances, this Special Issue features 7 research articles and 8 reviews, covering a broad spectrum of the advanced catalysis for renewable energy conversion and storage: electrocatalysis, photocatalysis, photoelectrocatalysis, and thermal catalysis.

Focusing on water splitting reactions for green hydrogen production, there are three review articles about the design of new catalysts including 2D metal-organic frameworks (MOFs) (Q Zhang et al., DOI: 10.1002/sstr.202200109) and Ni-based MOFs (D H Taffa et al., DOI: 10.1002/sstr.202200263), and advances in in situ characterization platforms (J-F Li et al., DOI: 10.1002/sstr.202200201). Four research articles introduce new photocatalytic hydrogen processes based on mesoporous semiconductors (R Marschall et al., DOI: 10.1002/sstr.202200184) and 2D carbon nitride catalysts (L Wang et al., DOI: 10.1002/sstr.202200264), photoelectrochemical water oxidation using doped titania nanotubes (K Maeda et al., DOI: 10.1002/sstr.202200229), and porous carbon based electrocatalytic water splitting reactions (Y Yamauchi et al., DOI: 10.1002/sstr.202200235). B-Y Xia et al. present their perspectives on water splitting at a larger scale, discussing the challenges and strategies for proton-exchange-membrane-based water electrolyzers (DOI: 10.1002/sstr.202200130).

To mitigate the carbon dioxide impact on our environment, H Jang and co-workers review single-atom catalyst design for electrocatalytic $CO_2$ reduction (DOI: 10.1002/sstr.202200236), and R Xu et al. present a research article on the 2D covalent organic framework catalysts for $CO_2$-to-CO conversion (DOI: 10.1002/sstr.202200233). J Scott's team focuses on the conversion of $CO_2$ to valuable light olefins (DOI: 10.1002/sstr.202200285). Relating to the concept of catalytic process for value-added products, G Wu and co-workers present the electrochemical nitrate conversion to ammonia (DOI: 10.1002/sstr.202200202), whereas J Liang and co-workers provide a critical overview on the electrocatalytic ammonia oxidation reactions (DOI: 10.1002/sstr.202200266). In a research article, K Nakajima's team demonstrate their strategy to catalytic de-hydration of glucose to hydroxymethylfurfural (HMF) (DOI: 10.1002/sstr.202200224). By using the concept of synergistic catalysis, B-Q Li, Q Zhang, and co-workers investigate

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high-performing catalysts for an energy storage system of lithium-sulfur batteries (DOI: 10.1002/sstr.202200205).

The guest editors do wish this special issue can shed light on the catalytic reaction mechanism and understanding of rational catalyst design in this fast-growing research field. We believe that the sustained research effort in rational *Small Structure* innovation would make big impact on sustainable energy supply and climate change.