**Catalysts for Gas-Involved Energy Reactions**

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Various gas-involved, key and clean energy reactions, driven by (photo)electrocatalytic processes, including oxygen reduction reaction (ORR), oxygen evolution reaction (OER), hydrogen evolution reaction (HER), nitrogen reduction reaction (NRR), and carbon dioxide reduction reaction (CRR), have attracted tremendous research interest for the sake of clean, renewable, and efficient energy technologies. However, these heterogeneous reactions exhibit sluggish kinetics due to multistep electron transfer and only occur at triple-phase boundary regions. Therefore, much effort has been devoted to the development of cost-effective and high-performance photocatalysts and electrocatalysts to boost the activities as promising alternatives to noble metal benchmarks.

On top of the prolific achievements in materials science, the advances in interface chemistry are also very critical in consideration of the complex phenomena proceeded at triple-phase boundary regions, such as mass diffusion, electron transfer, and surface reaction. Therefore, insightful principles and effective strategies for a comprehensive optimization, ranging from active sites to electrochemical interface, are necessary to fully enhance the catalytic performance aiming at practical device applications.

We have designed a series of efficient electrocatalysts and photocatalysts with multiscale principles in terms of electronic structure, surface chemistry, hierarchical morphology, and electrode interface. They have been applied in ORR, OER, HER, NRR, CRR, as well as the relevant practical applications in metal-air batteries, water splitting devices, fuel cells, etc.

**References**

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