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Developing Photocatalyst by Post-Synthetic Modification Metal-Organic Frameworks

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The much-needed renewable alternatives to fossil fuels can be achieved efficiently and sustainably by converting solar or mechanical energy to fuels via hydrogen generation from water or CO_2 reduction. Sunlight-driven H_2 production and CO_2 reduction are promising routes for the production of chemical feedstocks as fuel precursors to mitigate the CO_2 concentration in the atmosphere and also to alleviate the global energy crisis.[1-4] Nature's design of carrying out the photosynthetic redox cycle involving CO_2 and water inspired us to develop highly efficient integrated catalytic systems for artificial photosynthesis. The versatile and highly amenable structural tunability of metal-organic frameworks (MOFs) by post-synthetic modification (PSM) allows for tailoring inherent semiconducting and optoelectronic properties, compared to traditional inorganic semiconductors. Besides, PSM is an excellent choice for introducing a functional photosensitizer into the MOF matrices to galvanize the electronic, optical and piezoelectric properties towards H_2O and CO_2 reduction.[1-2] Our presented results demonstrated an excellent approach to green H_2 production and carbon neutralization for tackling the energy crisis.[1-6] The groundbreaking contributions to the design and development of metal–organic frameworks (MOFs) were globally acknowledged when the 2025 Nobel Prize in Chemistry was awarded, marking a milestone recognition of MOFs as one of the most important families of functional materials in modern chemistry and materials science.

My talk will focus on their broad significance as functional materials and on advancing integrated photocatalytic systems through post-synthetic modification of MOFs for H_2O and CO_2 reduction.

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