Functional frameworks as platforms for energy conversion and storage

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The conversion of sunlight into storable chemical fuels has been identified as a viable strategy to alleviate future energy shortage. To this end, the development of efficient photocatalysts capable of splitting water into hydrogen and oxygen has become a major thrust in materials science.
While heterogeneous systems excel through their stability, homogeneous catalysts offer the potential to tune every step in the photocatalytic mechanism through molecular engineering. Combining the best of both worlds thus opens up new possibilities for the design of tailor-made photocatalysts. Here, I will discuss the development of polymeric photocatalysts based on 1D or 2D carbon nitrides and covalent organic frameworks (COFs),[1] which are earth-abundant and molecularly tunable classes of organic semiconductors. Possible catalyst optimization strategies – through doping[2] exfoliation,[3] active site engineering,[4] and hybridization with bio-inspired co-catalysts[5] – will be reviewed and the potential of nitrogen-rich frameworks for carbon capture and storage applications will be discussed.

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