PHOTOCATALYSIS

A matter of size

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Photocatalysts can convert CO_2 to a range of products, including some that are suitable as fuels, such as methane. Photocatalysts typically comprise two different components — a semiconductor that can absorb light and generate excited electrons to drive the reaction and a co-catalyst that facilitates the conversion of the reactant to the product. The nature of the co-catalyst can impact the rate at which the products form (the catalyst's activity) and their identity (the catalyst's selectivity); understanding exactly how the co-catalyst's properties affect catalytic performance is therefore important to designing optimal catalysts. Now, Mingyang Xing and colleagues in China investigate the impact of the size of nanoparticulate Pt co-catalysts in photocatalytic CO_2 conversion, finding a significant effect of Pt particle size on both catalytic activity and selectivity.

The researchers prepare a set of photocatalysts with hierarchically ordered TiO_2–SiO_2 materials as the light absorber, onto which they grow Pt nanoparticles of different average particle size, ranging from 1.8 to 7.2 nm, while maintaining a constant Pt loading of 2 wt%. The catalysts containing the smallest Pt nanoparticles exhibit the highest activity for production of CH_4, as well as H_2, which is generated in the competing water reduction reaction. However, selectivity for CH_4, the desired product, increases from 39.1% to 79.1% on going from the smallest to the largest particle size. The experimental results, backed up by theoretical calculations, suggest that it is the terrace sites on the Pt nanoparticles that are the most active sites for CH_4 production, while low coordinate sites, such as those found at the corners and edges of the nanoparticles, are the most active for H_2 production.

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