Single atom co-catalysts in photocatalytic H_2 generation

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In 1972 Fujishima und Honda (1972) reported on the use of TiO_2 as a solar-illuminated semiconductor for the splitting of water into H_2 and O_2. Meanwhile, a large body of literature exists on photocatalytic H_2 generation using a wide variation of semiconductors, morphologies, and strategies to split water using the semiconductors suspended in an aqueous solution (with or without sacrificial agents). Many semiconductors have in common that for an efficient transfer of photogenerated charge carriers, a co-catalyst is required. For electron transfer and H_2 generation mostly Pt nanoparticles are used that are deposited onto the semiconductor surface by various techniques. Due to the precious nature of Pt, over the years, numerous efforts have been devoted to the shrinkage of the particle size and thus to enhance the utilization of the noble metal – in the most extreme case down to an insulated single atom of Pt.

In the presentation we discuss the use of Pt dispersed and anchored as single atoms (SAs) on TiO_2 surfaces and the activation to a most efficient use for photocatalytic H_2 generation. We discuss various trapping and stabilization approaches of SAs on photocatalysts that prevent agglomeration (and according deactivation of SA Pt). Moreover, we show that only a small amount of Pt (loading density of SAs) is needed to achieve a maximum activity of a semiconductor surface.

References

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