Plasmonic-catalytic 2D Supercrystals for H_2 Production

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Abstract— Our work outlines a groundbreaking approach in photocatalysis, introducing a novel class of photocatalysts that merge optical and heterogeneous catalysis principles. This innovation involves the combination of plasmonic nanoparticles with catalytic metals to harness visible light for chemical reactions. The investigations conducted so far focus on understanding the energy transfer mechanisms from plasmonic to catalytic centers to optimize the photocatalytic efficiency. Key studies include the structure-performance correlation [1, 2], the conversion of light into heat [3], and the benefits of transitioning to a 2D planar configuration [4]. Our experimental and theoretical studies point out the convenience of employing antenna-reactor configurations, in which catalytic metals positioned in close proximity to plasmonic nanoparticles primarily exploit the highly confined electric fields to form both excited holes and electrons participating later on in chemical transformations. We propose the development of a 2D supercrystal structure with optimized optical hotspots and exceptional hydrogen production during Formic Acid dehydrogenation. This research paves the way for advancements in sustainable energy production through plasmonic bimetallic photocatalysts.

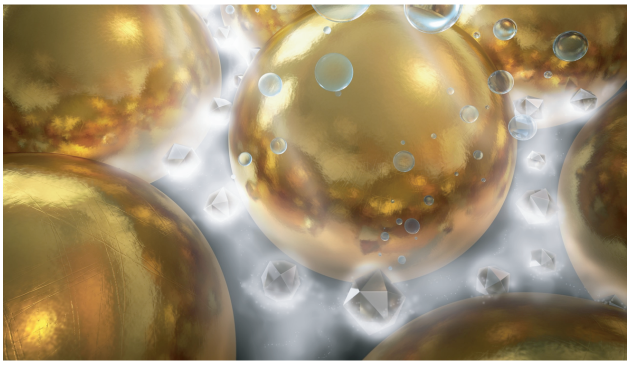

Figure 1: Illustration of Plasmonic Bimetallci 2D supercrystals. Small catalytic metallic nanoparticles located at the interparticle gaps of plasmonic nanoparticles network can boost their performance in H_2 generation by taking advantage of highly confined electric fields in the optical hotposts.

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