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Bimetallic Alloyed Plasmonic Photocatalysts for Efficient and Selective Heterogenous Hydrogenation

Stanford researchers have designed a light-driven bimetallic alloyed plasmonic photocatalyst that can both effectively and selectively catalyze heterogenous hydrogenation. Metallic heterogenous catalysts produce more than 80% of chemical products, but the high activation barrier of the reaction often requires burning petroleum fuel, which leads to emission of greenhouse gases and formation of undesirable byproducts. The Dionne group at Stanford has developed a next-generation bimetallic catalyst consisting of a light-interaction plasmonic material (Ag, Au, etc.) as well as a catalytically active material (Pd/Pt). Optical excitation of the light-interactive material generates plasmons, collective oscillation of conductive electrons, which offers a chemical scaffold for a unique chemical reaction that may not be accessible by traditional catalysis. The researchers have carefully designed and balanced the system for optical properties and inherent activities to achieve both high yields and selectivity without greenhouse gas emissions. This new catalyst can be applied broadly to many hydrogenation reactions at current industrial chemical plants.

Applications

- Chemical catalyst used in heterogenous hydrogenation
    - E.g., Hydrogenation of acetylene into ethylene in plastic production
- Environmentally-friendly production
    - CO_2 Reduction
    - Green steel manufacturing
    - Plastic Upcycling

Advantages

- Energy-efficient, solar-driven catalysis process
- Fine-toned chemistry for both high yields and selectivity
- Free from greenhouse gas emissions
- Broadly applicable to any heterogenous catalysis involving hydrogen-based chemistry

Publications

- Angell, D. K., Bourgeois, B., Vadai, M., & Dionne, J. A. (2022). Lattice-Resolution, Dynamic Imaging of Hydrogen Absorption into Bimetallic AgPd Nanoparticles. *ACS nano*, 16(2), 1781-1790.

Patents

- Published Application: 20230364597

Innovators

- Jennifer Dionne
- Alan Dai
- Briley Bourgeois
- Daniel Angell
- Dayne Swearer
- Lin Yuan

Licensing Contact

David Mallin

Licensing Manager, Physical Sciences

Email