Photoelectrochemically active 2D heterostructure based on MoS_2/Borophene for Hydrogen Evolution

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The search for sustainable energy sources has led to increased research into utilizing solar energy for hydrogen production through photoelectrochemical (PEC) processes. Molybdenum disulfide (MoS_2) has attracted considerable attention among the materials studied due to its impressive electronic and catalytic properties. Additionally, the emergence of borophene, a new two-dimensional (2D) material composed of boron atoms, has provided new opportunities for boosting the performance of MoS_2-based catalysts. Borophene possesses outstanding electronic properties and tunable band structures, making it an excellent candidate for enhancing the PEC activity of MoS_2.

In this presentation, I will discuss the fabrication, characterization, and application of MoS2/borophene heterostructures for efficient hydrogen evolution. The investigations involved various applications, including photocatalytic, electrochemical, and photoelectrochemical studies of hydrogen evolution from water-splitting reactions. The structural and electronic properties of MoS2/borophene heterostructures were investigated using advanced characterization techniques, including Transmission Electron Microscopy (TEM), Atomic Force Microscopy (AFM), X-ray Diffraction (XRD), Raman spectroscopy, and Electron Paramagnetic Resonance (EPR).

Evaluation of H_2 generation from MoS_2/borophene under simulated solar irradiation showed enhanced hydrogen evolution rates compared to unmodified MoS_2 in PEC. Ex-situ studies unveiled the synergistic effect between borophene and MoS_2, elucidating the mechanisms behind the enhanced PEC activity. Furthermore, testing the stability and durability of MoS_2/borophene catalysts during prolonged PEC operation demonstrated robust performance over extended periods.

This study highlights the potential of MoS_2/borophene heterostructures as a promising candidate for efficient solar-driven hydrogen evolution, offering insights into the design and advancement of catalytic materials for sustainable energy applications. These findings contribute to the ongoing efforts to advance renewable energy technologies and lay the groundwork for the commercialization of next-generation PEC systems.

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