POM/2D NANOCOMPOSITES AS ENERGY MATERIALS

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Water is a key energy vector, enabling green hydrogen production through the hydrogen evolution reaction (HER). Platinum remains the benchmark HER catalyst due to its near-zero overpotential and optimal hydrogen binding energy, yet its scarcity and cost hinder large-scale application. The oxygen evolution reaction (OER) poses the main bottleneck for overall water splitting because of its high thermodynamic demands and sluggish kinetics. Developing cost-effective, efficient, and stable HER and OER catalysts thus remains a central challenge.[1]

Two-dimensional materials (2DMs) are promising catalytic platforms thanks to their large surface area, mechanical stability, and excellent electronic conductivity. Their ultrathin nature shortens electron transport paths and enhances charge separation, leading to improved catalytic activity. Among them, transition metal dichalcogenides (TMDs) and layered double hydroxides (LDHs) show notable performance in both HER and OER, often further improved by interfacial engineering with co-catalysts, e.g., polyoxometalates (POMs).[2,3]

POMs possess exceptional redox versatility and unique physicochemical properties, including rapid multielectron transfer and stabilization of mixed-valence intermediates. When interfaced with solid substrates, POMs act as efficient electron–proton reservoirs, generating synergistic interfacial effects that enhance activity and durability. POMs have also been widely explored as standalone water-splitting catalysts, and their structure–activity relationships guide rational design strategies for improved efficiency.[4-6]

Heterogenizing POMs on 2DM supports combines molecular precision and structural stability, yielding hybrid nanomaterials with synergistically enhanced water-splitting performance. In this work, I present our latest advances in the synthesis of POM/2DM nanocomposites for HER and OER electrocatalysis.

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