Electrochemically Desulfurized Molybdenum Disulfide (MoS_2) - Graphene Aerogel Composites As Highly-Efficient Electrocatalysts for Hydrogen Production

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ABSTRACT

Electrocatalytic water splitting resulting in hydrogen production using platinum (Pt) and palladium catalysts has high impact in energy generation. However, high cost hinders their widespread applications. Recent developments in graphene and related materials including molybdenum disulfide (MoS_2) are gaining popularity as efficient and cost-effective catalysts. In this work, we prepared few-layer molybdenum disulfide (MoS_2) and aerogels with reduced graphene oxide (rGO) hydrothermally as nanocatalysts and electrochemically desulfurize for accelerated hydrogen evolution reaction (HER) activity via point defects (S-vacancy) in basal plane and exposed edge sites. Moreover, the interaction between rGO and MoS_2 create emergent hetero-interfaces with desirable physicochemical properties (specific surface area, mechanical strength, faster diffusion, facile electron and ion transport). The applied desulfurization potential and operating duration is varied for controlled HER activity. This unique method of tuning the properties of MoS_2 is promising for creating noble metal-free catalysts. We also performed electrochemical stability tests to confirm long-term operation of the catalysts and established *structure-property-catalytic activity correlations*.