Enhancement of the hydrogen evolution reaction with Ni doped MoS2 hybrid cluster catalyst

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As a representative member of the transition metal dichalcogenides (TMD) family, the abundant material of MoS_2 has considerable promise as a catalyst for the hydrogen evolution reaction (HER) [2]. It is believed that the Mo-edge sites are the main active sites in the reaction [2]. DFT calculations have demonstrated that the catalytic activity can be further improved by transition metal doping (Fe, Co, Ni) at S-edge sites [3]. Here, we report a novel methodology for the preparation of transition metal-MoS_2 hybrid nanoclusters based on a one step, dual-magnetron sputtering and gas condensation process, demonstrated for Ni-MoS_2. Aberration-corrected STEM images coupled with EDX analysis confirm the presence of Ni and MoS_2 in the hybrid nanoclusters. The Ni-MoS_2 nanoclusters display a 100 mV shift in the hydrogen evolution reaction onset potential and an almost 3-fold increase in exchange current density compared with the undoped MoS_2 nanoclusters, in agreement with reported DFT calculations.

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