Hybridisation of cobalt phosphide-molybdenum

ABSTRACT

Efficient electrocatalysts of cobalt phosphide (CoP)-molybdenum disulfide (MoS2) nanostructures were prepared by hydrothermal method with various CoP: MoS2 ratios (1:1, 2:1, and 1:2) to investigate the effect of CoP-MoS2 hybridisation for hydrogen evolution reaction (HER). The crystal structures of the prepared nanostructures were analysed by using X-ray diffraction (XRD) analysis, while morphological studies were conducted via Field Emission-Scanning Electron Microscopy (FE-SEM) and Transmission Electron Microscopy (TEM). The electrocatalytic performance of the resulting composites was evaluated under both acidic and alkaline conditions. XRD pattern commonly shows the Bragg reflections of CoP and MoS2 phases, indicating the presence of both phases in the resulting nanostructures. The materials also exhibit distinct morphologies, with rod-like CoP nanoparticles of ~50 nm in diameter and a distribution of MoS2 spheres on the surface of CoP nanorods. The formation of CoP-MoS2 composite nanostructures led to higher HER electrocatalytic activity in acidic condition, with an overpotential of 181 mV, which was lower than those of pristine CoP (209 mV) and MoS2 (275 mV). Similarly, the HER activity under alkaline condition also showed a smaller overpotential of 238 mV compared to that of pristine CoP (493 mV) and MoS2 (634 mV). These results highlight the beneficial effect of hybridisation of CoP and MoS2 in enhancing electrocatalytic performance, primarily attributed to the synergistic effect between both species.