Electrochemically Overgown MoO_{3-x}–Pt Mixed Nanoflakes on Bulk MoS_2 Surface and Their Application to Electrocatalysis

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Here we present an *in situ* electrochemical process to synthesize MoO_{3-x}–Pt mixed nanoflakes (NFs) overgrown on commercial bulk MoS_2 by using a facile and simple electrochemical method. The overgrowth of MoO_{3-x}–Pt mixed NFs on the bulk MoS_2 surface is conducted by applying electrical energy to the bulk MoS_2 in an acidic solution. The synthesized MoO_{3-x}–Pt mixed NFs demonstrate excellent catalytic performance with an overpotential of 69 mV (*vs.* SHE) at −10 mA/cm^2 and a Tafel slope of 53 mV/dec for electrochemical hydrogen evolution reaction (HER), comparable with the values (62 mV (*vs.* SHE) and 32 mV/dec) of commercial Pt black despite of ultra low Pt loaded amounts (about 30–40 times lower than commercial Pt black) in the MoO_{3-x}–Pt mixed NFs. These outstanding HER characteristics are related to the existence and increase of oxygen vacancy sites such as Mo^{5+} (known as the HER active sites) and MoO_{3-x}–Pt interfacial sites in the MoO_{3-x} NF structures.