Synthesis of galaxite, $\text{Mn}_{0.9}\text{Co}_{0.1}\text{Al}_2\text{O}_4$, and its applications a novel nanocatalyst for electrochemical hydrogen evolution reaction

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Abstract

A new compound $\text{Mn}_{0.9}\text{Co}_{0.1}\text{Al}_2\text{O}_4$ nanowires were synthesized by thermal method. The resulting powder samples were characterized by scanning electron microscopy (SEM), energy-dispersive X-ray spectroscopy (EDX), and X-ray diffraction (XRD). We found that a set of phase transformation occurred during the process. Eventually, five phases including three spinal phases, the corundum ($\alpha\text{-Al}_2\text{O}_3$) and MnO were formed at 1100 °C. As dominant morphology, the cubic galaxite nanowires were identified by X-ray analysis. Moreover, X-ray analysis showed that Mn_3O_4 and Co_3O_4 nanoparticles were formed in tetragonal and cubic symmetry respectively. The SEM image revealed that a dominate morphology of product has cubic nanowires shape with an average diameter in range 38–43 nm. Furthermore, we observed that influence of temperature was very important in the nanowire formation process. Electrochemical hydrogen evolution reaction (HER) of synthetic composite was evaluated and the over potential of HER was calculated about 110 mV with low Tafel slope equal to 42 mV dec⁻¹, which was comparable with amounts reported transition metal dichalcogenides with satisfying durability.

Keywords: Galaxite, HER, Nanocatalyst, Graphene.