Development of alternative electrode for dye-sensitized solar cell by FeNi/graphene synthesis using dry plasma reduction

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This study presents the development of FeNi alloy nanoparticles (NPs) which are alternate counter electrodes for use in dye-sensitized solar cells of optimum chemical state, synthesized at various volume ratios of Fe and Ni precursor using dry plasma reduction under low temperature and atmospheric pressure. Formation of FeNi alloy on RGO surface was confirmed by TEM measurement. Well-dispersed Fe1-xNix ($0 \leq x \leq 1$) NPs ranging in size from 2 to 4 nm are stabilized with RGO. The Fe0.7Ni0.3/RGO nanohybrid exhibited the highest electrocatalytic activity, corresponding to the lowest charge transfer resistance of 0.17 Ω, among the electrodes tested. As a result, the DSC made of Fe0.7Ni0.3/RGO CEs shows the greatest efficiency of 4.11% due to the optimization of the charge-transfer resistance and the diffusion impedance values of the developed materials. This technology development process is simple and efficient for fabricating cost-effective CE materials in DSCs and fabricating efficient catalysts for other uses as well, such as in methanol oxidation and oxygen reduction reactions.