Synthesis of Graphene-PtRu alloy nanohybrid materials using dry plasma reduction as a low-cost material for the counter electrode of dye-sensitized solar cells

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A dye-sensitized solar cell (DSC) has attracted considerable attention as a next-generation solar cell. Pt is considered to be one of the best materials as a CE for DSCs. However, the scarcity and high cost of Pt limit the mass production of the DSCs. Recently, graphene and PtRu alloys are employed as CEs for DSCs. In this study, we first report the one-pot synthesis of a PtRu alloy/reduce graphene oxide (RGO) nanohybrid materials and their application as a CE in DSCs. Bimetallic PtRu nanoparticles with the size range of 4 ~ 10 nm were uniformly immobilized on the surface of RGO with simultaneous co-reduction of precursor ions and graphene oxides to bimetallic atoms and RGOs, respectively, through dry plasma reduction under an atmospheric pressure and near room temperature without using any toxic reducing agents. The resulting nanohybrid materials with very small amount of metals exhibited low charge-transfer resistance, low diffusion impedance and high conductivity. The application of developed materials as an alternative CE for DSCs led to high energy conversion efficiency which was comparable to the DSC with the state-of-the-art CE.