Highly Efficient Electrodes for Dye Sensitized Solar Cells Based on Graphene Oxide

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Abstract

The dye sensitized solar cell (DSC) is an attractive alternative to solid state photovoltaics [1,2]. The generic device is a photoelectrochemical DSC with sensitized nanocrystalline titanium dioxide photoanode, electrolyte solution with a redox mediator and the counterelectrode. The latter is typically a film of Pt nanoparticles on F-doped tin oxide (FTO) and the former is the triiodide/iodide couple in aprotic electrolyte medium. Recently, this couple was exchanged with Co(III/II)-based redox mediators [3,4]. The obvious motivation consisted in enhancing the voltage of DSC. Graphene nanoplatelets (GNP) exhibit high electrocatalytic activity for Co(III/II) based mediators [5,6]. Graphene oxide (GO) showed almost no activity as DSC cathode, resembling the properties of basal plane pyrolytic graphite. However, the activity of GO improved dramatically upon reduction with hydrazine and/or heat treatment. The reduced GO or GO/GNP composite films are favored by excellent adhesion to FTO and by higher stability against aging. All GO-containing films were firmly bonded to FTO which contrasted with the poor adhesion of sole graphene nanoplatelets to this support. The activity loss during long-term aging was considerably improved, too. Enhanced stability of GO-containing films together with high electrocatalytic activity is beneficial for application in a new generation of dye-sensitized solar cells employing $Co(bpy)_3^{3+/2+}$ as the redox shuttle.

References

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