Replacing platinum by carbon nanomaterials in efficient DSSCs

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Abstract

Colloidal graphite (CG) and reduced graphene oxide nanomaterials were deposited by spin coating on fluorine doped tin oxide (FTO) substrates and the resulting nanostructured electrodes were characterized by a variety of experimental microscopic and spectroscopic techniques. The performed analysis has shown that the optical and electronic properties of the carbon electrodes depend on the precursor nature, its concentration and the number of the deposited layers. Tafel plots confirmed that the constructed electrodes show excellent electrocatalytic activity towards the $Co(bpy)3^{3+}$ reduction. Robust dye-sensitized solar cells (DSSCs) based on nanostructured titania film electrodes sensitized with D35 organic dye have been prepared employing the Co(bpy)3(PF6)2/Co (bpy)3(PF6)3-based redox electrolyte. Both colloidal graphite and reduced graphene oxide films are excellent counter electrodes (CE) in DSSCs, surpassing in efficiency the commonly used very expensive platinum (Pt) analogues and considerably reducing the cell fabrication costs. Electrochemical impedance spectroscopy (EIS) confirmed that the higher performance of the low cost and efficient carbon nanomaterials is due to lower electron transfer resistance at the corresponding electrolyte/counter electrode interface, in agreement with voltammetry (LSV and CV) experiments showing high stability and faster charge-transfer rate for carbon electrodes than that obtained for Pt. Our results show that the cobalt (II/III) couple works as a very effective electronic shuttle, enabling fast charge transfer at the carbon-based counter electrode and also efficiently regenerating the oxidized dye on the surface of the sensitized photoelectrode [1,2].

References

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