Synthesis of Ni-Mo-S nanosheets @ nitrogen-doped graphene hybrid for dye sensitized solar cell

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1. Introduction

Dye-sensitized solar cell (DSSC) is one of promising candidates for harnessing solar power and alternatives to conventional silicon solar cells. Counter electrode plays a vital role in determining the efficiency of DSSC. Still today Pt-coated FTO was utilized due to its high catalytic activity. However, high cost, corrosive, high temperature processing leads to replacement of Pt. To overcome this problem, we report novel Ni-Mo-S @ nitrogen doped graphene (NG) hybrid counter electrode.

2. Synthesis and fabrication of Ni-Mo-S/NG hybrid counter electrode

0.5 mmol of nickel acetate, sodium molybdate and 2.0 mmol of thiourea were dissolved in 10 mL of deionized water (DI) and stirred for 30 min. 45 mg of graphene oxide (GO) was dispersed in 15 mL of DI water and sonicated for 30 min to obtain a homogeneous dispersion of GO. Both the solutions were mixed and stirred for 30 min. It was transferred to 50 mL of Teflon-lined autoclave at 180 °C for 12h. The synthesized sample was spray coated on a FTO substrate with a thickness of about 10 µm and annealed at 300 °C in argon atmosphere. The morphological, optical and electrochemical properties were measured.

3. Result and discussion

Fig. 1a shows that all X-ray diffraction (XRD) peaks corresponded to rhombohedral phase of $NiMo_3S_4$. The sharp peak at 26.1° indicated graphene formation. Fig. 1b shows that square and rectangle 2D Ni-Mo-S nanosheets were anchored on the surface of nitrogen doped graphene. Fig. 1c shows the cyclic voltammetry analysis of counter electrodes. The peak to peak separation between anodic and cathodic peaks is directly related to electrochemical rate constant of redox reaction and the current density of cathodic peak related to electrocatalytic activity. The separation between the anodic and cathodic peaks (Epp) for Ni-Mo-S@NG hybrid was showed lower Epp (223 mV) and higher current density, when compared to other counter electrodes (Pt (239mV) and NG (251 mV)). This results directly related to enhancement of electrocatalytic activity towards the I^-/I_3^- redox reaction.

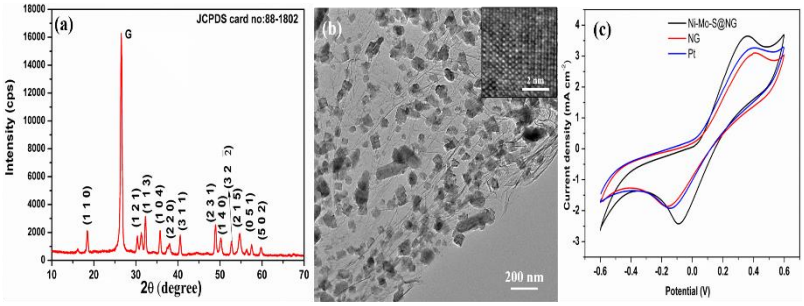

Fig.1 (a) XRD (b) TEM image of Ni-Mo-S@NG (c)TEM image of GO (c). CV curves verified in three electrode system I^-/I_3^- reduction (scan rate: 50 mVs^{-1}).

4. Conclusion

Ni-Mo-S@NG hybrid showed enhanced electrocatalytic activity and redox reaction compared to other counter electrodes.