Metal sulfide nanosheet–nitrogen-doped graphene hybrids as low-cost counter electrodes for dye-sensitized solar cells

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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. Pt-coated FTO has been utilized owing to its high catalytic activity. However, high cost, corrosive, high temperature processing lead to replacement of Pt. To overcome this problem, we report novel Cu-Mo-S @ nitrogen doped graphene (NG) hybrid counter electrode.

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

0.5 mmol of copper 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 square-like two-dimensional Cu-Mo-S nanosheets were anchored on the surface of nitrogen-doped graphene. Fig. 1b & c shows the cyclic voltammetry analysis of counter electrodes. The peak to peak separation between anodic and cathodic peaks (Epp) is directly related to electrochemical rate

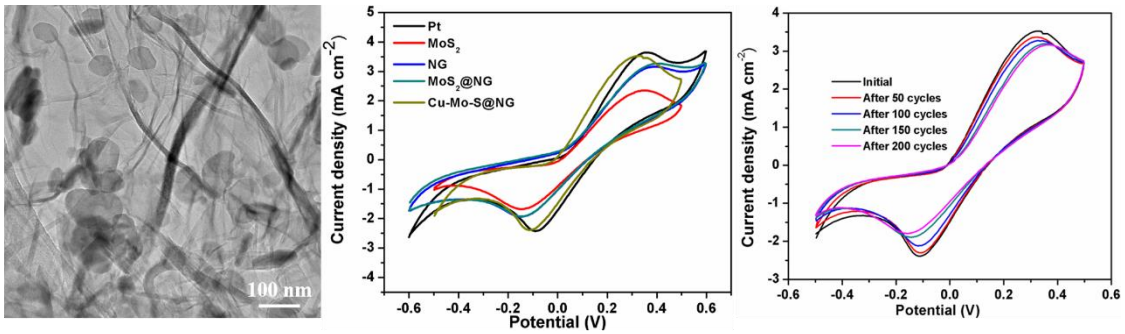

Fig.1 (a). TEM image of Cu-Mo-S@NG,(b). Electrocatalytic activity of hybrids, (c). Stability of Cu-Mo-S@NG hybrids

constant of redox reaction and the current density of cathodic peak related to electrocatalytic activity. The separation between Epp for Cu-Mo-S@NG hybrid showed lower Epp (432 mV) compared with other counter electrodes (Pt 450 mV, NG 542 mV, MoS_2@NG 532 mV and MoS_2 504 mV), This result related to enhancement of electrocatalytic activity towards the I^-/I_3^- redox reaction. Cu-Mo-S@NG showed good stability in the catalytic activity even after 200 cycles.

4. Conclusion

Cu-Mo-S@NG hybrid showed enhanced electrocatalytic activity, stability and redox reaction.