Cathodic electrodeposition of cobalt sulfide thin films for dye-sensitized solar cells and supercapacitors

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In recent years, nanostructured metal sulfides have attracted extensive attention in hydrogenations, dye-sensitized solar cells (DSSCs), supercapacitors (SCs) and lithium ion batteries. As an important class of metal sulfides, cobalt sulfides have been employed as low-cost electroactive materials which are capable of substituting for DSSCs material Pt and SCs material RuO_2, respectively. Up to now, cobalt sulfide nanostructured have been synthesized by different method. However, the aforementioned metal sulfides still needed polymer binders and conducting agents coating on conductive substrate, which could contribute extra contact resistance. Nevertheless, electrodeposition seems to be a great approach to prepare the electroactive materials on conductive substrates since the active materials can be directly growth on substrates without using any polymer binders and conducting agents, and the weight and thickness of electroactive materials can easily controlled by adjusting the deposition parameters.

In this current work, nanostructured CoS thin filns can be directly grown on a fluorine-doped tin oxide (FTO) glass and a Ni foam substrate as a catalystic material and an electroactive material for DSSCs and SCs, respectively, by simply using a facile potentiodynamic deposition method. The cell with the nanostructed CoS counter electrode exhibited a good photovoltaic conversion efficiency (6.33%), which is even superior to that of the cell using conventional Pt counter electrode. Additionally, the CoS thin film used as an electrode ion SCs revealed a high specific capacitance of 1471 Fg^{-1} at charge–discharge current density of 4 Ag^{-1}. Thus, the CoS thin film could be a promising candidate as a counter electrode and an electrode material for DSSCs and SCs.