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Hydrothermal synthesis of MoS_2 nanostructured films as high performance counter electrodes for dye-sensitized solar cells

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A semi-transparent MoS_2 film with surface exposed layered nanosheet structure were successfully grown onto Fluorine-doped Tin Oxide (FTO) conducting substrates by a facile one-pot hydrothermal method. After calcination, the as-prepared MoS_2 nanosheet films were directly applied as Counter Electrode (CE) in iodide/tri-iodide redox mediator based dye-sensitized solar cells (DSSCs). The hydrothermal reaction temperature and molar ratio of reaction precursors were realized to have significant impact on the overall properties of MoS_2 films and thereby photovoltaic (PV) performance. The ultra-thin MoS_2 nanostructured film with surface exposed layered nanosheet structure can be obtained by hydrothermal treatment of the reaction solution including $(NH_4)_6Mo_7O_{24}{\cdot}4H_2O$ and NH_2CSNH_2 with a molar ratio of 1:28 at 150°C for 24 h followed by calcination at 400°C under Ar atmosphere. The synthesized MoS_2 films displayed the Photo-Conversion Efficiency (PCE) as high as 7.41%, which was ~4% higher than that obtained from Pt-based DSSCs (7.13%). The superior electrocatalytic properties reflected on the final PV performances could be due to high stability, good electrical conductivity, rich electrocatalytic active sites and good electrolyte transport property of the resulting MoS_2 film. This study demonstrated the feasibility of developing low-cost and abundant metal chalcogenide electrocatalysts having high electrocatalytic activity to replace Pt-based electrocatalyst for DSSCs.

Biography

Mohammad Al-Mamun obtained his BS and MS degrees in Chemistry from Shahjalal University of Science and Technology, Bangladesh. Currently, he is a PhD candidate in Griffith University at the Griffith School of Environment, Australia. His current research focuses on the application of functional nanomaterials for energy conversion technologies, including DSSCs, OER, ORR and HER. He has published more than 10 papers in international peer-reviewed journals.

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