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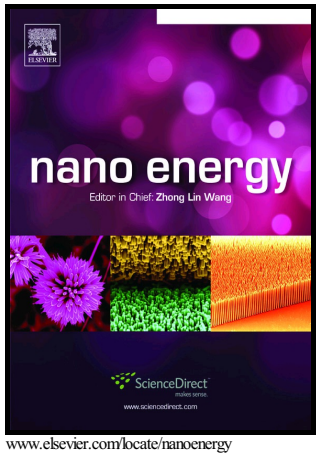

www.elsevier.com/locate/nanoenergy

PII: S2211-2855(16)30020-9
DOI: http://dx.doi.org/10.1016/j.nanoen.2016.03.009
Reference: NANOEN1187

To appear in: *Nano Energy*

Received date: 26 November 2015
Accepted date: 11 March 2016

Cite this article as: Hua Zhang, Cong Wang, Wenxiang Peng, Cheng Yang and Xinhua Zhong, Quantum dot sensitized solar cells with efficiency up to 8.7% based on heavily copper-deficient copper selenide counter electrode, *Nano Energy,* http://dx.doi.org/10.1016/j.nanoen.2016.03.009

Quantum dot sensitized solar cells with efficiency up to 8.7% based on heavily copper-deficient copper selenide counter electrode

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Abstract

Semiconductors such as sulfides have been commonly used as counter electrodes (CEs) in quantum dot sensitized solar cells (QDSCs) with high stability and catalytic activity. But the intrinsic unsatisfactory conductivity has been making researchers find alternative materials for further improving the efficiency. Here nanometer sized copper selenides substrated on F-doped SnO_2 (Cu_xSe/FTO) are used as CE in the construction of QDSCs. Through optimizing the composition and structure variables of the CE materials, including Cu/Se ratio, film thickness, sintering temperature and time, we achieve the power conversion efficiencies up to 6.49% and 8.72% for CdSe and CdSeTe based QDSCs, respectively. Our results show that the excellent photovoltaic performance is strongly associated with the low Cu/Se molar ratio in the range of 1.20 to 1.38, suggesting the heavily deficient copper in Cu_xSe. The resultant good conductivity and electrochemical catalytic activity of the Cu_xSe/FTO CE have been verified by the electrochemical impedance spectroscopy, Tafel polarization and four-probe measurement results.

Keywords: Cu_xSe; counter electrode; high efficiency; sensitized solar cell; copper deficiency