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Carbon nanofibers with surface-attached platinum nanoparticles as cost-effective and efficient counter electrode for dye-sensitized solar cells

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Dye-sensitized solar cells (DSCs) have attracted incredible attention as a relatively inexpensive alternative to silicon solar cells. Conventionally, a transparent fluoride-doped tin oxide (FTO) conductive glass that is coated with a thin layer of platinum (Pt) is used as counter electrode in DSCs. The reason for the widespread use of Pt as counter electrode in DSCs is its catalytic ability to enhance the reduction of I3- ions in electrolyte. However, Pt is costly and the corrosive nature of the I-/I3- redox couple may significantly deteriorate Pt's catalytic activity and hence affect the long-term stability of DSCs. In this study, carbon nanofibers with surface-attached Pt nanoparticles were prepared by electrospinning polyacrylonitrile (PAN) solution followed by the stabilization and carbonization of PAN precursor nanofibers and subsequent Pt nanoparticle growth on carbon nanofiber surface via redox reaction. The obtained carbon/Pt composite nanofibers were then employed as cost-effective counter electrode in DSCs. The effects of size, morphology, and loading of Pt nanoparticles on the performance of DSCs were investigated. Compared to conventional counter electrode, the counter electrode that was made of carbon nanofibers with surface-attached platinum nanoparticles exhibited higher fill factor (FF) and larger open circuit voltage (Voc). DSCs containing the carbon/Pt composite nanofiber counter electrode demonstrated good solar energy conversion efficiencies in the range of 7% and 8%.

Biography

Alex Aboagye received his B.S. and M.S. degrees in Chemical Engineering from Kwame Nkrumah University of Science and Technology, Ghana, and North Carolina Agricultural and Technical State University, respectively. He joined Prof. Zhang's research group at the Joint School of Nanoscience and Nanoengineering, North Carolina A&T State University in spring 2012 and is now pursuing a Ph.D. degree in nanoengineering. His research interests include ceramic and carbon nanomaterials and their applications.

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