4th International Symposium on
Energy Challenges & Mechanics
- working on small scales

11-13 August 2015
Aberdeen, Scotland, UK

ZnO-based hetero-nanostructures using an optimized solution process for solar energy conversion application

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Accepted for publication on the 25th of January 2015

In this study I will present ZnO nanowires and their heterostructures for solar energy conversion applications. ZnO nanowire arrays and quantum-dot/ZnO heterostructure nanowires were applied as photo-electrodes in quantum dot sensitized solar cells. ZnO nanowires were fabricated by low temperature solution reaction. Various QDs have been applied including CdS, CdSe, Ag2S, etc. Quantum dots were deposited on ZnO nanowires by solution reactions, such as chemical bath deposition (CBD) and successive ion layer absorption and reaction (SILAR). The deposited quantum dots showed uniform dispersion on ZnO nanowires. ZnO nanowires provide direct charge transfer through 1-dimensional structure and high surface area. However this material has wide band-gap energy and absorbs only UV region light. However QDs applied in this study has lower band-gap energies and they are efficient in absorbing visible light region of solar spectrum. Additionally the QDs have stepwise type-II band structures with ZnO nanowires and thus it enables efficient charge separation and transport. Thus our quantum dot sensitized solar cells showed highly enhanced solar energy conversion efficiency. Also we have studied the applications of these nanostructures for photoelectrochemical (PEC) hydrogen generation via solar water splitting. QDs/ZnO nanowires were applied as photoelectrode in PEC cells. The durability of the PEC cell was studied and the application of catalyst enhanced the durability of the PEC cells. Additionally the passivation of solar cells using superhydrophobic nanowires was also investigated. Biomimicking Lotus leaf, chemically modified nanowires were applied to provide superhydrophobicity on the solar cell surfaces. This simple passivation drastically enhanced the durability of the solar cells, including perovskite solar cell, a promising next generation solar device.

Keywords: