

Nanostructure Assemblies for Solar Energy Conversion

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Significant research efforts have been made in recent years to design next generation light harvesting assemblies in order to meet the clean energy demand. Nanostructure architectures and molecular assemblies offer new platforms to harvest light energy. Of particular interest are the CdSe based Quantum Dot Solar Cells (QDSC), which have shown promise towards the development of all-inorganic solar cells with long term stability. Quantum dot sensitized solar cells (QDSC) are assembled using different size CdSe quantum dots on TiO₂ films composed of particle and nanotube morphologies. The difference in the conduction band energy of two semiconductors serves as a driving force for the interparticle electron transfer. Ways to improve power conversion efficiency and maximize the light harvesting capability through the construction of a rainbow solar cell and carbon nanotube-semiconductor hybrid assemblies will be presented. Carbon nanostructures such as single wall carbon nanotubes and graphene can serve as scaffolds to anchor semiconductor and metal nanoparticles. In particular, graphene based nanostructures have been found to be useful for boosting the performance of light energy conversion devices. The role of graphene oxide in accepting and shuttling photogenerated electrons in solar cells and photocatalysis will be discussed.

Selected Publications

- [1]. P. V. Kamat, Graphene-based Nanoassemblies for Energy Conversion *J. Phys. Chem. Lett.*, **2011**, 2, 242.
- [2]. Kamat, P. V.; Tvrđy, K.; Baker, D. R.; Radich, J. G. Beyond Photovoltaics: Semiconductor Nanoarchitectures for Liquid Junction Solar Cells *Chem. Rev.* **2010**, 110, 6664–6688.
- [3]. Bang, J. H.; Kamat, P. V., Solar Cell by Design. Photoelectrochemistry of TiO₂ Nanorod Arrays Decorated with CdSe. *Adv. Funct. Mater.* **2010**, 20, 1970-1976.
- [4]. Wojcik, A.; Kamat, P. V. Reduced Graphene Oxide and Porphyrin. An Interactive Affair in 2-D *ACS Nano* **2010**, 4, 6697–6706.
- [5]. J. H. Bang and P. V. Kamat, Quantum Dot Sensitized Solar Cells. A Tale of Two Semiconductor Nanocrystals: CdSe and CdTe *ACS Nano*, **2009**, 3, 1467.