Harvesting solar energy through dye-sensitized and quantum dot solar cell

Relentless efforts are underway allover the world to develop a low cost efficient solar cell for the solution of global energy crisis. Dye sensitized solar cell (DSSC) appeared to be one of the good discovery for the solution of energy problem. We have been involved in studying ultrafast interfacial electron transfer dynamics in DSSC using femtosecond laser spectroscopy. However it has been realized that it is very difficult to design and develop higher efficient one, due to thermodynamic limitation. Again in DSSC most of the absorbed photon energy is lost as heat within the cell, which apart from decreasing the efficiency also destabilizes the device. It has been realized that quantum dot solar cell (QDSC) are the best bet where the sensitizer dye molecules can be replaced by suitable quantum dot (QD) materials in solar cell. The quantum-confinement effect in semiconductors modifies their electronic structure, which is a very important aspect of these materials. For photovoltaic applications, a long-lived charge separation remains one of the most essential criteria. One of the problems in using QDs for photovoltaic applications is their fast charge recombination caused by non-radiative Auger processes, which occur predominantly at lower particle sizes due to an increase in the Coulomb interaction between electrons and holes. Various approaches, such as the use of metal–semiconductor composites, semiconductor–polymer composite, and semiconductor core–shell heterostructures, have been attempted to minimize the fast recombination between electrons and holes. To make higher efficient solar devices it has been realised that it is very important to understand charge carrier and electron transfer dynamics in QD and QD sensitized semiconductor nano-structured materials. In the present talk, we are going to discuss on recent works on ultrafast electron transfer dynamics in dye-sensitized TiO2 nanoparticles/film and charge (electron/hole) transfer dynamics in quantum dot core-shell nano-structured materials.