Department of Chemistry, IIT Madras

RESEARCH PROPOSAL SEMINAR

Name: Malay Krishna Mahato (CY16D042) Date: 03/09/2019

Venue: CB 310 Time: 3:00 p.m.

Understanding the Excited State Charge Transfer Dynamics and Charge Transport in Quantum Dots: Key Aspect to Improve the Performance of Photovoltaics

Solar cell converts the most renewable energy, sunlight, into electricity and significant research has been carried out in the field due to the ever increasing demand for clean energy.[1] The third generation solar cells aim to substantially increase the power conversion efficiencies (PCE) of the devices at an economically viable cost. The maximum attainable theoretical efficiency for single junction first and second generation solar cells is 32.9% (Shockley –Queisser (SC) limit).[2] However, the simplicity of synthetic procedure and outstanding properties of the three dimensionally confined semiconductor materials [knows as quantum dots (QDs)] such as high absorption cross section, size dependent optical tunability, offer the possibility to overcome the SC limit through multiple-exciton generation (MEG) and hot carrier extraction process. Coupling the QDs with organic or inorganic materials to manipulate the electron-hole separation and their transport across their interface with minimum recombination loss is one of the main strategies to improve the conversion efficiency in QD-based solar cell.[3] In this context, understanding the underlying fundamental photo-physics of charge carrier separation and recombination in QDs becomes essential to achieve better power conversion efficiency (PCE) of quantum dot solar cells. The presentation will provide an overview of the excited state dynamics of QDs, followed by the research hypothesis and initial results[4] obtained using various optical spectroscopic techniques such as transient pump probe method in systems based on CdTe QDs and graphene QDs.

References

(1) Kamat, P. V. Boosting the Efficiency of Quantum Dot Sensitized Solar Cells through Modulation of Interfacial Charge Transfer. *Accounts of Chemical Research* **2012**, *45*, 1906-1915.

(2) Shockley, W.; Queisser, H. J. Detailed Balance Limit of Efficiency of P- n Junction Solar Cells. *J. Appl. Phys.* **1961**, 32, *510-519*.

(3) Kamat, P. V. Quantum Dot Solar Cells . The Next Big Thing in Photovoltaics. *J. Phys. Chem. Lett.* **2013,** 4, 908-918.

(4) Mahato, M. K.; Govind, C.; Karunakaran, V.; Nandy, S.; Sudakar, C.; Prasad, E. Enhanced Charge Transport and Excited-State Charge-Transfer Dynamics in a Colloidal Mixture of CdTe and Graphene Quantum Dots. *J. Phys. Chem. C* **2019,** 123, 20512-20521.

Signature of the Guide

Signature of the coordinator 27.08.2019.

Signature of HOD