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Effect of Different Ligands on Carrier Dynamics of CdSe Quatum Dots for Solar Cells Applications[1] BAICHHABI R. YAKAMI, URICE TOGHA, University of Wyomning, MEG MAHAT, University of North Texas, SHASHANK R. NANDYALA, MILAN BALAZ, JON M. PIKAL, University of Wyomning, DEPARTMENT OF ELECTRICAL AND COMPUTER ENGINEERING TEAM, DEPARTMENT OF CHEMISTRY TEAM, DEPARTMENT OF PHYSICS TEAM — We have carried out steady state absorption and photoluminescence (PL), as well as time resolved PL and ultrafast transient absorption (TA) studies of CdSe quantum dots (QD) with five different capping ligands: trioctylphosphine oxide (TOPO), oleic acid (OA), dodecanethiol (DDT), mercaptopropionic acid (MPA), and L-cysteine (Cys). These ligands have different chemical structures and which effects the optical properties of the QDs. Measurements were conducted on QD sizes ranging from Ø = 2.5nm to 4.6nm with smaller QDs showing an excitonic PL and a broad surface trap state PL. The ligand exchange of OA CdSe QDs with MPA, DDT and Cys leads to quenching of excitonic PL intensity accompanied by a larger surface trap state to excitonic PL intensity ratio. This is consistent with the TRPL measurements, which show faster exciton PL decays for CdSe QDs with MPA, DDT and Cys ligands compared to OA and TOPO. The PL decay shows multi-exponential behavior with the average lifetime decreasing with increasing QD size. Data from TA experiments using a white light probe is also used to study the picosecond carrier dynamics. These measurements shed light on the role of capping ligands on the carrier dynamics of the QD used as sensitizers in solar cells.

[1]U.S. Department of Energy

Baichhabi R. Yakami
University of Wyomning

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