ABSTRACT

Perovskite solar cells has been the fastest growing solar cell material till date with verified efficiencies of over 22%. Most groups in the world focuses their research on solution based devices that has residual solvent in the material bulk. This work focuses extensively on the fabrication and properties of vapor based perovskite devices that is devoid of solvents.

The initial part of my work focuses on the detailed fabrication of high efficiency consistent sequential vapor NIP devices made using P3HT as P-type Type II heterojunction. The sequential vapor devices experiences device anomalies like voltage evolution and IV hysteresis owing to charge trapping in $TiO\_{2}$. Hence, sequential PIN devices were fabricated using doped Type-II heterojunctions that had no device anomalies.

The sequential PIN devices has processing restriction, as organic Type-II heterojunction materials cannot withstand high processing temperature, hence limiting device efficiency. Thereby bringing the need of co-evaporation for fabricating high efficiency consistent PIN devices, the approach has no-restriction on substrates and offers stoichiometric control. A comprehensive description of the fabrication, Co-evaporator setup and how to build it is described. The results of Co-evaporated devices clearly show that grain size, stoichiometry and doped transport layers are all critical for eliminating device anomalies and in fabricating high efficiency devices.

Finally, Formamidinium based perovskite were fabricated using sequential approach. A thermal degradation study was conducted on Methyl Ammonium Vs. Formamidinium based perovskite films, Formamidinium based perovskites were found to be more stable. Lastly, inorganic films such as CdS and $NiO\_{x}$ were developed in this work.