INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Programme of Study	:	Ph.D.

Thesis Title: Design and Development of ZnO Morphologies for Enhanced Photovoltaic Characteristics: Synthesis, Characterization and Fabrication of Photoanodes for Semiconductor Quantum dot/ Dye Sensitized Solar Cells

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SHORT ABSTRACT

Morphology dependency of photovoltaic properties in terms of charge transport and efficacy in light harnessing ability has been studied in the presented thesis. Environmentally benign structure directing chemicals which are commonly available in the laboratory are employed to generate superstructures of ZnO with favorable optical and charge transport properties and evaluated their solar-to-current conversion efficiencies. Particularly interesting results are development of novel morphologies with excellent photovoltaic properties such as, hexagon shaped ZnO nanodisks (NDs), nanorods, mesoporous ZnO cages and 3D microspheres etc. Hexagon shaped ZnO NDs with exposed ±(0001) polar facets sensitized with CdS/CdSe QDs shows a remarkable power conversion efficiency (PCE) values. Results show that enhancement is primarily due to (i) efficient charge separation and collection boosted by the exposed ±(0001) facets (ii) better light-scattering ability and (iii) high BET surface area for sensitizer particle adsorption. ZnO cages with compacted 1D building blocks provide faster and efficient charge transfer pathways for photogenerated electrons, higher specific surface area as well as better light scattering ability to afford a high PCE. We have also presented an idea to enhance the PCE of the devices by utilization of a bi-layered ZnO based photoanode with a combination of 3D ZnO microspheres (ZnO HMSP) and vertically grown 1D ZnO NWs on FTO substrate. A ~74% and ~35% enhancement in PCE are achieved as compared to the pristine 1D ZnO NW and ZnO HMSP based solar cells respectively. We have also demonstrated a practical strategy to boost light harnessing ability of ZnO based QDSSCs by introducing graphitic carbon nitride (g-C_3N_4) in the photoanodic segment.