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Harvesting Photons with Semiconductor Quantum Dots

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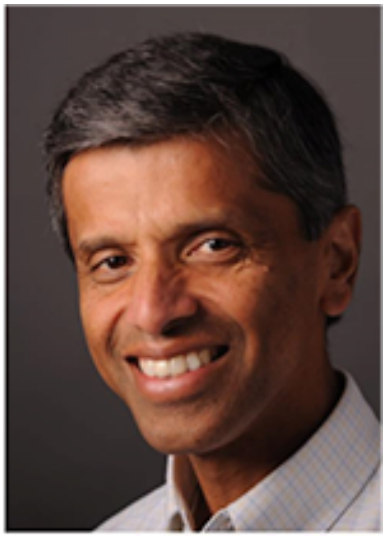

Assembling semiconductor nanostructures on electrode surfaces in a controlled fashion is an attractive approach for designing next generation solar cells. In recent years, quantum dot solar cells (QDSC) have emerged as the potential contender for making transformative changes. The size dependent electronic structure of quantum dots enables the design of photovoltaic devices with tailored electronic properties. We have now exploited this aspect in solar cells by assembling different size CdSe quantum dots on mesoscopic TiO_2 films either by direct adsorption or with the aid of molecular linkers. Upon bandgap excitation, CdSe quantum dots inject electrons into TiO_2 thus enabling the generation of photocurrent in a photoelectrochemical solar cell. The dependence of electron transfer rate constant on the energy gap and its implication in photoconversion efficiency of quantum dot solar cells will be discussed. Crystalline ternary cadmium chalcogenides (CdSeS) have been deposited within the mesoscopic TiO_2 film by electrophoretic deposition with a sequentially layered architecture. This approach has enabled us to design tandem layers of CdSeS QDs of varying bandgap within the photoactive anode of Quantum Dot Solar Cell (QDSC). Recent advances in the development of high efficiency QDSC and new emerging strategies will be discussed.