Transforming Next Generation Photovoltaics with Semiconductor Nanostructures

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Silicon photovoltaics are regarded as part of green energy technology. However, they carry significantly longer (as high as 3 years) energy payback time. Semiconductor nanostructures are finding new ways to design light energy conversion devices (e.g., thin film solar cells and light emitting devices). The thin film design enabled through low temperature processing decreases the energy payback time. The decreased consumption of energy during the manufacture and the lessened use of semiconductor materials lowers the overall carbon footprint with energy payback time less than a year. The early studies focused on the synthesis of various semiconductor nanostructures and exploration of their size dependent optical and electronic properties. Careful engineering efforts in recent years have led to their integration in high efficiency thin film solar cells. Metal halide perovskite solar cells, in particular can now deliver efficiencies greater than 26%, thus matching the power conversion efficiency of silicon solar cells. Recent developments in utilizing semiconductor quantum dots for light energy conversion devices and how they can influence decreasing carbon footprint will be discussed. Efforts are needed to address the stability issues, to assess environmental impacts and to transform current practices of energy utilization.

Additional Readings

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[3] DuBose, J. T.; Kamat, P. V., Hole Trapping in Halide Perovskites Induces Phase Segregation. Accounts of Materials Research 2022, 3, 761-771

[4] DuBose, J. T.; Kamat, P. V., Energy Versus Electron Transfer: Managing Excited-State Interactions in Perovskite Nanocrystal–Molecular Hybrids. Chemical Reviews 2022, 122, 15, 12475–12494

[5] Kamat, P. V.; Kuno, M., Halide Ion Migration in Perovskite Nanocrystals and Nanostructures. Accounts of Chemical Research **2021**, 54 (3), 520-531.

Biography

Prashant V. Kamat Prashant V. Kamat is a Rev. John A. Zahm, C.S.C., Professor of Science in the Department of Chemistry and Biochemistry and Radiation Laboratory at the University of Notre Dame. He is also a Concurrent Professor in the Department of Chemical and Biomolecular Engineering. Professor Kamat has for more than three decades worked to build bridges between physical chemistry and material science to develop advanced nanomaterials that promise cleaner and more efficient light energy conversion. He has published more than 500 scientific papers that have been well recognized by the scientific community Thomson-Reuters has featured him as one of the most cited researchers each year since 2014 (2014 -2022). He is currently serving as the Editor-in-Chief of *ACS Energy Letters*.