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On the use of graphene in solar cells

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Abstract

Two-dimensional, single layer graphene sheets can be synthesized with epitaxial substrate and is stable from thermodynamic, interfacial, Euler, Landau-Pearls, layer agglomeration, wrinkle, corrugation considerations. Confirmed using Raman spectroscopy it is a distinct allotrope of carbon and the Nobel Prize in Physics went to A. Geim and K. Novosolev in 2010 for their work on graphenes. One of the interesting areas of their application is in solar cells. The use of graphene layer in solar cells can lead to higher light to electricity conversion as much as 15% and also lead to reduction in production costs. Graphene layer can replace the thin charge-carrying silicon layer that is expensive as shown by Peking University, China recently. Graphene can be used as an electrode. This is less expensive to fabricate. Light to electricity conversion efficiency of about 8.6 – 10.0% was shown to increase to 14.6% by coating a 65 nm thick layer TiO_2 atop silicon graphene solar cell. The amount of visible light reflected from the silicon surface is decreased to less than 10% from 30% on account of the coating.

Siemens has been developing PV photovoltaic cells using conducting polymers and discovery of more allotropes of carbon such as fullerenes, graphenes, CNTs etc. Thin film of conducting polymer and fullerenes are sandwiched between two electrodes. Photons are absorbed, electrons are generated and routed by fullerenes/graphenes with higher electron mobility toward the electrode. The optimization of solvents, temperatures and drying conditions for better blends of fullerenes and plastic lead to doubling of the power output. This was attributable to more jumps of electrons from plastic to fullerenes and more regular structuring of fullerenes and polymer. Further improvements in light to electricity conversion were achieved by manipulation of nanomaterial's and change to nano coating methods.

AR, antireflection coatings can be prepared using graphenes. This cuts down the losses of light by reflection and increases the light to power conversion efficiency.

Biography

Kal R. Sharma received his B.Tech in chemical engineering from Indian Institute of Technology, Chennai, India in 1985 and MS and PhD degrees in chemical engineering from West Virginia University, Morgantown, WV in 1987 an 1990 respectively. His post doctoral research training was under former chair and Prof. R. Shankar Subramanian, Clarkson University, Potsdam, NY, Chemical Engineering.

He is the author of 12 Books, 537 Conference Papers, 143 Articles/Bibliographic Archivals (7 Book-Chapters, 3 Review Articles) and 112 other presentations.

He has instructed 2830 students in India and USA in 103 courses. He is a Fellow of Indian Chemical Society and listed in Who's Who in America. He has reviewed over 30 Journal Articles. He serves on Editorial Boards such as, ChemXpress, Rajkot, India. Editorial Board, Caspian Journal of Applied Science and Research, Penang, Malaysia. Associate Editor, Journal of Scientific Research and Reports, Oxford/New York/Delhi. He serves as Adjunct Faculty at Lone Star College, University Park and instructs Industrial Electronics among other courses.

He has held high level positions in academia. He has received cash awards from Monsanto Plastics Technology, Indian Orchad, MA, SASTRA University, Thanjavur, India, Prairie View A & M University, Prairie View, TX.

He has received 14 press citations. His works have been cited more than 218 times in refereed journals. His book is required text in the graduate level course in electronics in Mumbai University, Mumbai, India.