Chirality Engineering on CNTs - A New Approach to Boost the Solar Cell Efficiency

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Abstract

The use of carbon nanotubes (CNTs) in a photovoltaic cell could have significant extrapolations on the commercial solar cell market. Two interrelated directions within CNT's research area are crucial to the ultimate success of the following endeavor accordingly: 1) structural engineering of CNTs (Separation, purification, and enrichment; 2) CNTs integration and a hole selective contact into solar cells as a photosensitive element. All these topics have experienced tremendous growth over past the 20 years. CNTs are an ideal two-dimensional material formed of sp_2-hybridized carbon due to their unique physical, thermal, and optical properties. The high robustness and high transparency of CNTs in the broad wavelength region make them a very attractive material for many components that are used in solar cells. Conventional solar cell efficiency is less than 30%. The goal of this work is to improve the efficiency of the solar cell by over 80% by applying the chirality engineering of the CNTs with a purification rate of above 98%. Therefore, this research is proposed the different structures of CNTs (SWCNTs and MWCNTs) have different radii and chirality to improve the efficiency of the solar cell. This proposed work will start by developing a mathematical model and verifying the results by using CAD Tools like COMSOL Multiphysics and MATLAB. The model will help to harvest the energy near to infrared that will be a milestone in the renewable energy sector by introducing the CNT-based solar cells having an efficiency of 80 % from the research lab to the end-user technology.

Keywords
Carbon Nanotube, CAD Tools, Chirality, Efficiency, Solar Cell

Biographies

Aamar Shabir joined Florida Polytechnic University in January 2021 as a student of master's in electrical engineering. He served as the trainee engineer in the AJK Electricity department in 2017-2019 and served INPRO Pakistan in 2019-2020 as a site engineer. Aamar did his undergraduate project on Induction Motors. Which covered the automated monitoring of induction motors parameters. He is a member of IEOM Society International and IEEE. He is also president of the IEOM Chapter at Florida Polytechnic University. Aamar is working on emerging materials carbon nanotubes to improve solar cell efficiency under the supervision of Dr. Muhammad Ullah. Since January 2021, he is studying master's program at Florida Polytechnic University.

Dr. Muhammad Ullah, Ph.D. Dr. Muhammad S. Ullah is an assistant professor of electrical and computer engineering at Florida Polytechnic University. His research focuses are the modeling of RLC interconnects in high density integrated circuits and energy-efficient electronic devices (TFET) for logic applications based on emerging 2-D nanomaterials (MoS2, Graphene, and CNT). He also worked on a neural network-based classification of deceptive and stress speech using non-linear spectral and cepstral features during his master's study. In his Ph.D. dissertation, he investigated the high-speed very-large-scale integration (VLSI)interconnect and energy-efficient electronic devices for emerging post-MOSFET and beyond silicon technologies. Before joining Florida Poly, Ullah worked as a full-time lecturer from 2008 to 2011 at the Chittagong University of Engineering & Technology (CUET), Bangladesh. From 2011 to 2013, he worked as a teaching assistant at Purdue University Northwest. He began working as a full instructor at the University of Missouri-Kansas City while he pursued his doctoral degree. He has taught undergraduate courses in electrical circuits, digital logic designs, signals and systems, and graduate courses in advanced digital signal

processing, introduction to VLSI designs, advanced VLSI designs, and emerging nanotechnology, including hands-on experience in MATLAB, Cadence Virtuoso, and HSPICE.

Ullah has served as a regular reviewer of many journals and conferences, including IEEE Transactions on very large scale integration systems, IEEE International Symposium on Circuits and Systems, IEEE Midwest Symposium on Circuits and Systems, Microelectronics Journal-Elsevier and Circuits, Systems and Signal Processing-Springer, and ASP Journal of Low Power Electronics.