Vijay K Arora, J Material Sci Eng 2017, 6:6(Suppl)
DOI: 10.4172/2169-0022-C1-075

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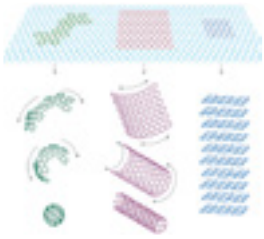
Graphene nanoelectronics

The rising era of graphene began with the award of the Nobel Prize in Physics 2010 jointly to Andre Geim and Konstantin Novoselov for groundbreaking experiments regarding the two-dimensional (2D) material with a honeybee lattice (Figure 1). Graphene can exist as 0D as fullerene, 1D as CNT, and 3D with multilayers. The experiments based on graphene have shown alternative material structures like phosphorene and silicene with expandable bandgap that is required for semiconductor devices. Its allotropes can form sensors as chemical elements react with the dangling bonds on the surface, thereby registering the presence of a chemical by enhanced transport properties. This review will first present the cohesive bandstructure as unique boundary conditions are applied to rolled-over graphene into CNT and small-width GNR, transforming 2D to 1D nanostructures. The transformed density of states and both the equilibrium and non-equilibrium distribution function define the carrier statistics and transformations of randomly oriented velocity vectors to streamlined ones in extreme non-equilibrium. Nonequilibrium Arora's Distribution Function (NEADF) is shown to possess distinct properties that are considerably different from Monte Carlo procedures and Nonequilibrium Green's function. The exceptional feature arising from the application of NEADF is the scattering-independence in the saturation region while ohmic mobility is strongly scattering-dependent. Moreover, it brings out vividly the velocity saturation as arising from the intrinsic velocity with a limiting value of the Graphene's Fermi velocity that is higher than the Fermi velocity in semiconductors. Ballistic transport where device length is smaller than the scattering-limited mean free path is shown to degrade the mobility. Resistance quantum is obtained in 1D configuration that is generalized to give contact resistance and channel resistance. Magnetotransport in graphene is discussed to demonstrate the utilization of magnetic field in characterization and performance evaluation.



Biography

Vijay K Arora has obtained his PhD from the University of Colorado, USA. In addition to his tenured appointment at Wilkes University, he is privileged to have held the distinguished visiting appointments at the University of Tokyo, National University of Singapore, Nanyang Technological University, University of Western Australia and Universiti Teknologi Malaysia. He was Chair of NanoSingapore 2006, NanotechMalaysia 2010 and EscienceNano 2012 conferences. He is listed in a number of Who's Who biographies. He has been invited to give keynote papers/lectures/courses at international forums, spanning from nanotechnology to nanoeducation to nanomanagement, both on and off a chip. He has published more than 100 papers in reputed journals and many uncounted publications in conference proceedings.

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