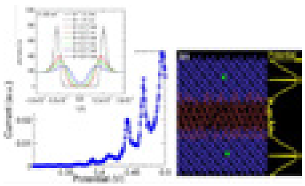
Somnath Bhattacharyya, J Material Sci Eng 2017, 6:6(Suppl)
DOI: 10.4172/2169-0022-C1-075

Somnath Bhattacharyya

University of the Witwatersrand, South Africa

Quantum device prospects of superconducting diamond films

Nanostructured semiconducting carbon system, described by as a superlattice-like structure demonstrated its potential in switching device applications based on the quantum tunneling through the insulating carbon layer. This switching property can be enhanced further with the association of Josephson's tunneling between two superconducting carbon (diamond) grains separated by a very thin layer of carbon which holds the structure of the film firmly. The superconducting nano diamond heterostructures form qubits which can lead to the development of quantum computers provided the effect of disorder present in these structure can be firmly understood. Presently we concentrate on electrical transport properties of heavily boron–doped nanocrystalline diamond films around the superconducting transition temperature measured as a function of magnetic fields and the applied bias current. We demonstrate signature of anomalous negative hall resistance in these films close to the superconductor-insulator-normal phase transition at low bias currents at zero magnetic field. Current vs. voltage characteristics show signature of Josephson-like behavior which can give rise to a characteristic frequency of several hundred of gigahertz. Signature of spin flipping also shows novel spintronics device applications. We are working towards utilizing the superconducting phenomena in nano diamond films in making some novel quantum electronic and high speed devices. This project complements our previous work on nitrogen-doped nano diamond films and related nanostructured carbon devices which showed interesting radio frequency features in the gigahertz range.



Biography

Somnath Bhattacharyya is a Professor in the School of Physics at the University of the Witwatersrand, Johannesburg, South Africa focusing on the area of condensed matter physics and nano-electronics. His major interest is in the transport properties of carbon and major achievements include the demonstration of resonant tunnel devices based on amorphous carbon, gigahertz transport in carbon devices, n-type doping of nanocrystalline diamond and developing theoretical models for transport in disordered carbon. His team focuses on the fabrication of the nano electronic devices, studying novel electronic properties of nanocrystalline diamond films and carbon superlattice structures at high magnetic fields and high frequencies. His group is also involved in performing theoretical modeling of carbon quantum structures. He is engaged in developing a new infrastructure for a wider range of nanotechnology that will include quantum matter, carbon based microwave detectors and nano- bio-electronics.

somnath.bhattacharyya@wits.ac.za