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Odd-frequency superconducting order parameter in Boron-doped nanocrystalline diamond films

Nanocrystalline diamond films can be described as a granular superconducting system with Josephson's tunneling between superconducting diamond grains separated by a very thin layer of disordered sp2 hybridized (i.e. graphene-like) carbon. Presently we concentrate on electrical transport properties of heavily boron–doped nanocrystalline diamond films around the superconducting transition point based on the Berezinskii-Kosterlitz-Thouless transition. The magnetoresistance (MR) of these films was found to change from negative to a positive value at a particular temperature close to this transition which is explained through the transition from weak localization to weak anti-localization effect. Through the application of a low bias current negative magnetoresistance (MR) features can be seen with periodic oscillatory features these are attributed to tunneling associated with non-s wave order parameters in a multi-junction system. Presence of an odd frequency superconducting order parameter has been claimed from pronounced zero bias conductance peak as well as spin valve-like effect in MR. Ultimately from the angle-dependent change of critical temperature as well as the MR peaks we demonstrate signature of spin triplet superconductivity in these films. The microstructure essentially forms a graphene on diamond system which has been suggested as a good candidate for topological insulator. Hence the superconducting nanodiamond heterostructures can be useful for developing topological qubits for quantum computing, some device concepts are thus discussed.

Biography

Somnath Bhattacharyya is a Professor in the School of Physics at the University of the Witwatersrand, Johannesburg, South Africa since 2012. After completing his doctoral degree from the Indian Institute of Science, Bangalore in 1997 he worked as a Researcher in the USA, Germany and England. In 2007 he established his new research group the nano-scale transport physics laboratory at the University of the Witwatersrand. 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. He has published four book chapters and over 70 papers in peer reviewed journals.

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