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Realization of High-speed Transport in Low Dimensional Disordered Carbon Films SOMNATH BHATTACHARYYA, MIKHAIL KATKOV, DMITRY CHUROCHKIN, GEORGE CHIMOWA, ROSS MCINTOSH, University of the Witwatersrand — Developing hybrid super-structures including carbon nanostructures for quantum information science is widely sought after and we show a possible route in carbon superlattice structures based on experimental results as well as theoretical analysis which also incorporates high-speed switching capabilities. We propose a theoretical model of disordered carbon superlattice structures where the local density of electronic states is controlled by changing the $sp^3 - C$ bond alternation as well as the hopping disorder parameter of the $sp^2 - C$ regions. In addition the incorporation of nitrogen atoms in carbon networks was modeled as a combination of disorders which vary both in correlated and uncorrelated manners. Resonant peaks associated with C and N sites in these structures show a conductance cross-over under variation of the nitrogen concentration in these structures which can explain the observed negative differential resistance in diamond-like carbon superlattices as well as the conductivity cross-over in nano-crystalline diamond films. Detailed analysis of transport measurements over a wide range of temperatures, magnetic fields and also frequency shows an enhanced characteristic length in these systems that supports switching of complex impedance in the range of 50 GHz.

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