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Understanding Quantum Transport and the Kondo Effect in 2D Carbon Systems ROSS MCINTOSH, DMITRY CHUROCHKIN, SOMNATH BHATTACHARYYA, University of the Witwatersrand — The rich physics surrounding correlations between conduction electrons and local spins in quantum dot systems is of significant interest towards the development of spintronic quantum information devices. In this study we establish the Kondo effect in reduced graphene oxide (RGO) films through a metal-insulator transition in resistance versus temperature interpreted within the Fermi liquid description of the Kondo effect and negative magnetoresistance which scales with a Kondo characteristic temperature. With a microstructure consisting of intact graphene nano-islands embedded within residual functionalized regions where local magnetic moments may form, RGO is effectively a disordered quantum dot system. This work is augmented with a theoretical study of transport through nano-scale multiple quantum dot devices. Solving within a Keldysh formalism we scrutinize quasi-bound state formation in a range of geometrical quantum dot configurations in order to interpret coherent quantum interference effects. We demonstrate negative differential conductance and control over device parameters such as the characteristic time. This tandem approach illustrates the promise of innovative low dimensional carbon spintronic devices.

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