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Graphene quantum dots: localized states, edges and bilayer systems

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Graphene quantum dots show Coulomb blockade, excited states and their orbital and spin properties have been investigated in high magnetic fields. Most quantum dots fabricated to date are fabricated with electron beam lithography and dry etching which generally leads to uncontrolled and probably rough edges. We demonstrate that devices with reduced bulk disorder fabricated on BN substrates display similar localized states as those fabricated on the more standard SiO_2 substrates. For a highly symmetric quantum dot with short tunnel barriers the experimentally detected transport features can be explained by three localized states, 1 in the dot and 2 in the constrictions. A way to overcome edge roughness and the localized states related to this are bilayer devices where a band gap can be induced by suitable top and back gate voltages. By placing bilayer graphene between two BN layers high electronic quality can be achieved as documented by the observation of broken symmetry states in the quantum Hall regime. We discuss how this method can be exploited to achieve smoother and better tunable graphene quantum devices. This work was done in collaboration with D. Bischoff, P. Simonet, A. Varlet, Y. Tian, and T. Ihn.