Electric transport and Raman Spectroscopy Measurements in Graphene Devices

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One of the most important recent developments in the physics of low dimensional systems was the demonstration that high quality, few layer graphene flakes could be produced, either by micromechanical exfoliation of graphite or by surface graphitization of SiC. This novel two dimensional system presents high room temperature mobilities and a set of interesting electric transport phenomena such as anomalous integer quantum hall effect observed even at room temperature and non vanishing conductivity when the density of charge carriers approaches zero. For instance, in single layer graphene, the electric transport can be described by considering that the carriers behave as two dimensional massless Fermions. For monolayer graphene this is a consequence of the peculiar linear dispersion relation in the vicinity of the K and K' points of the band structure, were the minima of the conduction band and the maxima of the valence band occur. In bilayer graphene the conduction and valence band are parabolic near the K and K' and a tunable band gap can be generated by the application of an electric field between the layer. One of the major challenges to explore the physics of graphene is the reliable fabrication of multiterminal devices with well defined geometries. The fakes obtained by micromechanical exfoliation are difficult to observe by optical microscopy, have irregular and unpredictable shapes and are randomly distributed over the oxidized Silicon substrate. In order to make devices first the flakes must the found and their position indexed with respect to alignment marks and then a well defined geometry is defined usually by a combination of e-beam lithography and reactive plasma etching. In this talk we will address fabrication methods of graphene devices using laser beam lithography were monolayer and bilayer graphene flakes can be observed and their position precisely found using a built-in infrared illumination, with the photoresist already on top of the substrate. We will address our recent results on the use of Raman spectroscopy to study the phonons and electronic structure of graphene, make an overview of our ongoing work in electric transport in graphene devices fabricated at UFMG and also of the future propects and developments that we expect to achieve.