RAMAN SPECTROSCOPY OF GRAPHENE EDGES

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Graphene edges are of particular interest since their orientation determines the electronic properties [1]. Furthermore edges are preferred doping sites [2].

Here we present a detailed Raman investigation of graphene flakes with edges oriented at different crystallographic directions. Very large graphene flakes (up to100 μm^2) with sharp edges are produced by micromechanical cleavage of graphite. Single-layer flakes are then identified by Raman Spectroscopy [3]. The angle between the edges is determined by optical microscopy and atomic force microscopy. The position, width, and intensity of G and D peaks are studied as a function of the incident light polarization. The D-band is strongest for polarization parallel to the edge and minimum for perpendicular [4]. Raman mapping shows that the D peak is well localized in proximity of the edge, while the D peak intensity is very small or absent inside graphene flakes [4].

For ideal edges, the D peak is zero for zigzag orientation and large for armchair [5], allowing in principle the use of Raman spectroscopy as a sensitive tool for edge orientation. However, here we show that for our samples, the D to G ratio does not show a significant dependence on edge orientation [4]. Here we show that the D to G peak ratio strongly depends on polarization, relative position of the laser spot with respect to the edge, and amount of edge disorder. Thus, even if edges can appear macroscopically smooth and oriented at well-defined angles, graphene edges are often mixed and disordered, at least on the laser spot scale. This shows that Raman spectroscopy is able to probe the degree of disorder of an edge.

References:

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