CREATION AND QUANTIFICATION OF DEFECTS IN MULTILAYERED GRAPHENE SAMPLES

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Abstract

The real graphene samples contains defects. Their correct quantification is crucial for both fundamental science and practical applications. In addition for specific applications like sensors or for graphene functionalization a controllable defect formation is required. Here we used oxygen plasma to induce defects in graphene samples composed of monolayer, bilayer with Bernal stacked layers and bilayer with randomly stacked (turbostratic) layers. In this way, we were able to compare the effects of the same plasma treatment on monolayers and bilayers, either Bernal stacked or randomly stacked. We used isotopic labelling of graphene layers by 13C, which allowed us to address the Raman bands from the top and bottom graphene layers. Our results showed that the phonons of the AB stacked bottom graphene layer can be scattered by defects in the top graphene layer. Considering this effect we found that monolayer graphene on top layer of turbostratic bilayer contains similar number of defects, while the top graphene layer contains much less defects after a given time of oxygen plasma treatment. This result is reasonable because it confirms the behaviour of top layer of turbostratic graphene independent on the bottom layer, while the reactivity of the top layer in AB stacked graphene is significantly reduced by interactions with the bottom layer. Our findings have important consequences regarding graphene applications, showing that the presence of defects varies not only with the number of layers but also with the stacking order. Moreover, the number of defects estimation might not always be accurate, especially in co-dependent layers such as in Bernal stacked graphene.

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