Graphene functionalization : A XPS layer dependent study

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Graphene based devices fabrication is currently impeded by its metallic behavior and its lack of reactivity making it hard to create graphene based transistors or sensors. In order to overcome this problem, various approaches to tune and control the electronic properties of graphene have been considered.
In this work, we investigate the controlled modification of graphene using mild oxygen (O_2) plasma treatment [1]. The treatments were performed on monolayer and bilayer graphene and graphite. The comparison between these three samples allows us to study the difference of reactivity when increasing the number of layers. X-ray photoelectron spectroscopy (XPS) using a micro beam probe is then performed on pristine and plasma modified graphene and graphite. This technique is able to give chemical bonding information on single exfoliated graphene flakes. We studied the carbon 1s peak evolution with different plasma parameters such as treatment time, power or sample position inside the chamber. The functionalized graphene layers present a shoulder at high binding energy (286-289 eV) which corresponds to carbon-oxygen bonds such as hydroxyl, carbonyl and carboxyl. We show that changing plasma parameters allows tuning of the functionalization. In addition, the amount and type of functional groups are found to vary with the number of graphene layers.

[1] A. Felten et al., Small, 2012, early view available online.