Functionalization of graphene by perylene

Laura Höltgen*
Kangho Lee*, John McManus#, Chanyoung Yim*, Rita Siris*, Corinna Weiss+, Frank Hauke+, Andreas Hirsch+, Georg S. Duesberg*#

* *Universität der Bundeswehr München, Werner-Heisenberg-Weg 39, 85577 Neubiberg, Germany*
# *School of Chemistry, Trinity College Dublin, College Green, Dublin 2, Ireland*
+ *Institut für Organische Chemie, Henkestr.42, 91054 Erlangen, Germany*

Laura.Hoeltgen@unibw.de

Due to its unique properties, graphene has been proposed for various applications in medicine, electronics, photonics, energy, sensors, and environment. For these purposes, large-scale graphene is required which is best produced by chemical vapor deposition (CVD). Further realization of these applications often demands tuning graphene's properties and modifying its surface. The primary focus of this study is the surface functionalization of transferred graphene on chip. To preserve its intrinsic properties non-covalent functionalization with aromatic molecules is carried out. A perylene derivative dissolved in tetrahydrofuran (THF) was applied onto graphene. Various characterization methods including Raman spectroscopy, scanning electron microscopy (SEM), atomic force microscopy (AFM), and electrical measurement are performed. The successful functionalization is verified by Raman spectroscopy. The effect of functionalization on the electrical properties is investigated by realizing a graphene field-effect transistor (GFET) array as shown in Figure 1. Half of the devices of the GFET were treated with THF, while the second half served as reference. This was followed by the functionalization of the whole array. Application of THF was detrimental to the devices, while a 20-35% mobility improvement is observed after functionalization with perylene in the reference devices (Figure 2). The measurements indicate that the transferred pristine graphene is p-doped in ambient conditions and n-doping takes place due to functionalization.

The work presented here is a promising step in improving GFET performance and functionalization strategies towards applications such as biosensing.

References

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Figures

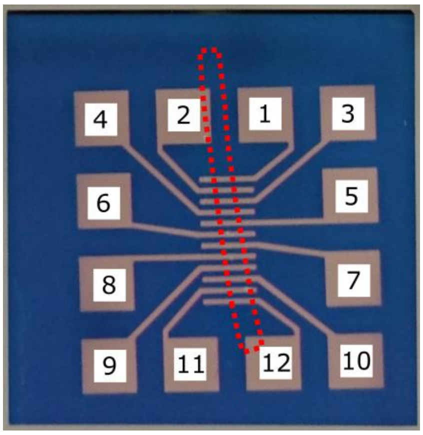

Figure 1: Graphene channel contacted with 12 electrodes resulting in a GFET array of 11 devices.

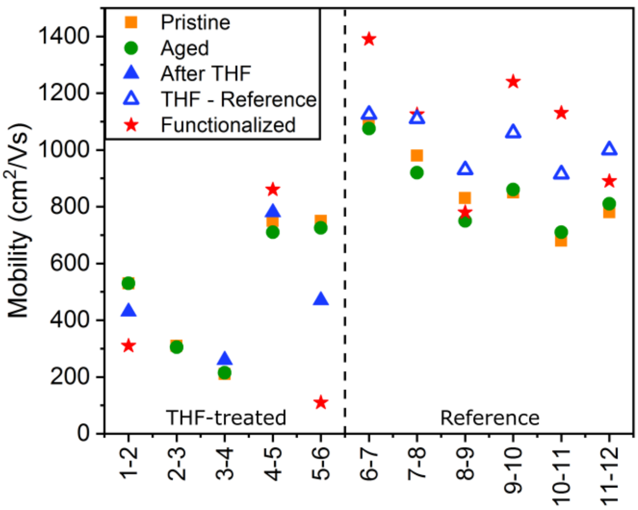

Figure 2: Charge carrier mobilities for 11 devices of a GFET, after various treatment steps.