

Functionalization of the hydrogenated chemical vapour deposition-grown graphene by on-surface chemical reactions

Karolina Drogowska

Petr Kovaříček, Martin Kalbáč
J. Heyrovsky Institute of Physical Chemistry
Czech Academy of Sciences
Dolejškova 2155/3, 18223 Prague, Czechia

Karolina.drogowska@jh-inst.cas.cz

One of the most efficient methods allowing manipulation and modification of the graphene properties is its chemical functionalization^{1,2}. Many applications have been already found for the hydrogenated graphene (graphane): opening the bandgap, enhancement of the spin-orbit coupling and appearance of the magnetic moment make it a great candidate for the purposes in spintronics, sensors or thermoelectric devices³⁻⁵.

Moreover, the prior hydrogenation of graphene may create the possibility for its further functionalization with the compounds that do not react with the pristine graphene.

We have investigated the reactivity of the pristine and hydrogenated graphene with KMnO_4 , KIO_4 and benzyl bromide (BnBr) using the Raman spectroscopy and SERS (Scheme of the reaction pathways is displayed in Figure 1). Reaction with KMnO_4 resulted with the recovering of the graphene due to its oxidative dehydrogenation what was confirmed by the vanishing of the D mode in the Raman spectrum. Significant increase of the D mode was observed after the oxidation of hydrogenated graphene with KIO_4 what was associated with the breakage of the C-C bonding. Raman spectrum of the hydrogenated graphene after alkylation with BnBr shows the peaks corresponding to the attached benzyl group.

Contrary to the hydrogenated graphene, the same reactions performed on the pristine graphene have not resulted with any changes in the Raman spectra.

References

- [1] C. K. Chua and M. Pumera, *Chem. Soc. Rev.*, 2013, **42**, 3222.
- [2] P. Kovaříček, Z. Bastl, V. Valeš and M. Kalbac, *Chem. – A Eur. J.*, 2016, **22**, 5404–5408.
- [3] T. H. Seah, H. L. Poh, C. K. Chua, Z. Sofer and M. Pumera, *Electroanalysis*, 2014, **26**, 62–68.
- [4] S. C. Ray, N. Soin, T. Makgato, C. H. Chuang, W. F. Pong, S. S. Roy, S. K. Ghosh, A. M. Strydom and J. A. McLaughlin, *Sci. Rep.*, 2014, **4**.
- [5] J. Balakrishnan, G. Kok Wai Koon, M. Jaiswal, A. H. Castro Neto and B. Özyilmaz, *Nat. Phys.*, 2013, **9**, 284–287.

Figures

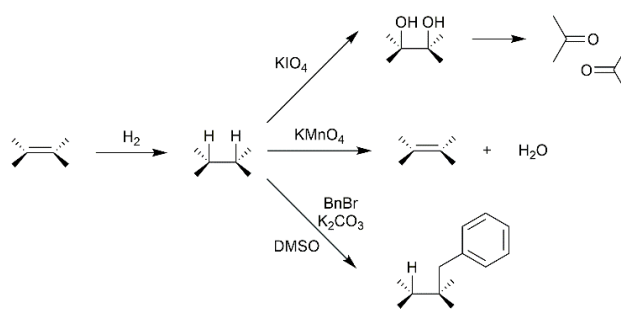


Figure 1: Schemes of the reaction pathways. Hydrogenated graphene was oxidized with KMnO_4 and KIO_4 as well as being alkylated with benzyl bromide (BnBr).