Supramolecular Approaches to Charge Transport Physics in Hybrid van der Waals Heterostructures

Emanuele Orgiu[1,2]

[1] *Institut de Science et d'Ingénierie Supramoléculaires, Université de Strasbourg, Strasbourg, France*
[2] *INRS-EMT & Université du Québec, Montréal (QC), CA*

Email:orgiu@unistra.fr web site: http://www.upgrade-network.eu

Graphene and the two-dimensional (2D) van der Waals semiconductors represent the thinnest, air stable semiconducting materials known. Their unique optical, electronic and mechanical properties hold great potential for harnessing them as key components in novel applications for electronics and optoelectronics. However, the charge transport behavior in such semiconductors is more susceptible to external surroundings (e.g. gaseous adsorbates from air and trapped charges in substrates) and their electronic performance is generally different than the corresponding bulk materials due to the fact that surface and bulk coincide when going from 3D down to 2D. Interestingly, one can take advantage of the latter property by using ordered supramolecular layers in order to tune charge transport and optical properties of such 2D materials. Hence, the electrical properties of graphene can be strongly influenced by the presence of physisorbed molecules, which induce charge transfer and doping[1]. In this context, supramolecular chemistry makes it possible to precisely tune the doping effect via the formation of ordered self-assembled monolayers (SAMs) of molecules embedding different functional groups[2].

In my presentation, I will give an example of a more general physical scenario: the charge transport and the doping on graphene can be tuned through *ad-hoc* engineering of the supramolecular assemblies physisorbed on its surface. A very fine photoreactivity process allows to achieve molecules featuring the same assembly motif on the surface but different terminal groups which contribute to doping the graphene in a novel way.

This approach will give an easy example of all the potential hidden in van der Waals heterostructures composed of supramolecular lattices physisorbed onto graphene.

1. Li et al. *Nanoscale* **5**, 9640(2013); S.-L. Li, K. Tsukagoshi, E. Orgiu, P. Samorì *Chem. Soc. Rev*. **45,** 118 (2016).
2. G. Preston, et al. *Chem Soc Rev*. **42**, 3(2012)