Graphene-organic composites as active materials and surface coatings for nanotechnology applications

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The term "graphene" refers to a single layer of carbon atoms, arranged in a honeycomb, highly conjugated lattice. The sheets have monatomic thickness and can have a lateral size of hundreds of microns.
While the outstanding physical properties of graphene are well-known, the full potential of graphene chemistry has not yet been fully exploited. Being based on sp^2 carbon atoms, the properties of graphene backbone can be tailored by making use of the many covalent and non-covalent approaches of carbon-based organic chemistry, thereby providing new functionalities to this already exceptional material, as well as enabling its large scale production and solution processing.
Graphene charge mobility is some orders of magnitudes *greater* than the one of silicon; moreover, graphene exhibits a strong chemical affinity with organic molecules, spanning from p-conjugated materials, to fullerenes and DNA.
Here, we give an overview of possible applications of graphene-organic composites, in particular related to recent results obtained in our group on the:

- Covalent functionalization of graphene sheets with optically active oligothiophenes.
- Charge transport in graphene-polythiophene transistors.
- Local current mapping and patterning of reduced graphene oxide.
- Self-assembling of organic molecules on graphene single sheets.

Overall, graphene chemistry can potentially allow seamless integration of graphene technology in organic electronics devices to improve device performance and develop new applications for graphene-based materials. An overview of running and future initiatives of joint research on graphene at European level will be also presented for discussion.

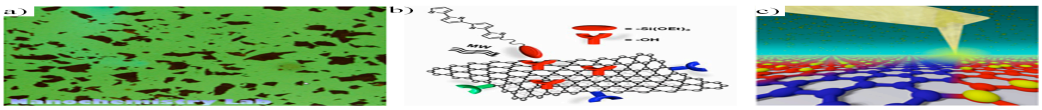

Figure 1: *a) fluorescence image of GO single sheets on a T4 self-assembled monolayer, b) Sketch of one-step chemical functionalization of graphene, c) cartoon depicting local GO electrochemical reduction with a scanning probe tip.*

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