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Fluorographene chemistry: broadening the family and scope of graphene derivatives

Functionalization of graphene enables tuning of graphene's surface and electronic properties, thus expanding its application potential. However, existing approaches based mainly on chemistry of graphene and graphene oxide achieve limited control on functionalization due to chemical inertness and non-selective attachment of various groups, respectively. Here we present an alternative route towards graphene derivatives based on fluorographene (FG), a stoichiometric and well-defined graphene derivative introduced in 2010.[1,2] It is a very hydrophobic material with a large band gap and it was considered rather unreactive, like Teflon.[1] However, recent studies have shown that FG is susceptible to reductive defluorination and nucleophilic attack.[3] The reactions result in homogeneously and selectively functionalized graphenes, with unprecedented functionalization degrees. Importantly, during functionalization, FG is defluorinated back to graphene, without affecting the already installed functional groups, unlike GO. Defluorination is triggered by the nucleophiles, which simultaneously initiate substitution and reductive defluorination. Typical examples are the carbon-carbon bond formation reactions on FG with Grignard reagents[4]or with the pseudohalide of -CN and its subsequent hydrolysis to "graphene-acid".[5] These findings demonstrate that FG is a very robust and reactive substrate towards the preparation of valuable graphene derivatives, suitable for applications spanning from spintronics to catalysis and energy storage. Acknowledgement: We gratefully acknowledge support from the Ministry of Education, Youth and Sports of the Czech Republic (LO1305 and CZ.1.05/2.1.00/19.0377 and the Research Infrastructure NanoEnviCz: project No. LM2015073), the ERC (Consolidator grant 683024 from the European Union's Horizon 2020 research and innovation programme), the Czech Science Foundation (P208/12/G016) and the Neuron fund.

Biography

Aristides Bakandritsos is Senior Researcher at Regional Centre for Advanced Technologies and Materials. He has been working with colloids for drug delivery applications, as well as with the synthesis of carbon/graphene colloids and networks. He has published >60 articles in peer reviewed journals (h-index of 20).

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