Editorial

Organic Functionalization of Carbon Nanostructures

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Graphite, diamonds, activated carbon, charcoal, nanodiamonds, carbon nanotubes, fullerenes, and more recently graphene and carbon quantum dots; for sure, carbon always finds its way to be on the spotlight of human's interest. In the past two decades, various carbon structures such as carbon nanotubes, fullerenes and more recently graphene/graphene oxide and carbon quantum dots have attracted the interest of the scientific community. Nowadays, more than ever, these carbon nanostructures have been in the research spotlight. Bonding and hybridization flexibility of carbon atoms, combined with the extraordinary physicochemical properties of these structures, settle them as ideal candidates for state-of-the-art applications.

On the other hand, organic chemistry is a powerful tool that enables the successful modification of various inorganic substrates and structures, forming hybrids and altering and/or tuning their physicochemical properties. Incorporation of appropriate functional organic groups and heteroatoms leads to desired tailored applicability of the final composites.

The present special thematic issue focuses on the organic functionalization of the carbon nanostructures aiming the production of novel materials with enhanced or even new properties. The targeted review articles of the issue record the newest developments in the organic functionalization of the most common carbon nanostructures and their applications. In this direction, the issue consists of the following invited reviews:

a) **Unravelling Radicals Reactivity towards Carbon Nanotubes Manipulation/Functionalization**, by *Zois Syrgiannis, Aurelio Bonasera, Eleonora Tenori, and Maurizio Prato*: Carbon Nanotubes (CNTs) chemistry is under constant evolution, as a consequence of the deep interest of the scientific community in finding new applications for these versatile materials. New and old synthetic protocols are used for improving the control of the functionalization degree of the final materials and for offering to scientists the possibility to fine-tune their final properties. This review focuses the attention on radical reactions, a class of protocols characterized by small number of steps, different degrees of functionalization and enhanced solubility of the final modified CNTs, in the desired environment. The most well-known protocols are analysed providing some relevant examples appeared in the literature in the last years, monitoring the new application fields and giving insights into their mechanism in order to explain why these protocols are considered standard procedures for a wide number of scientific groups.

b) **Solid State Physicochemical Properties and Applications of Organic and Metallo-Organic Fullerene Derivatives**, by *Efstratia Mitsari, Michela Romanini, Manesh Zachariah, and Roberto Macovez*: This review deals with the fundamental properties and main applications of organic derivatives and complexes of fullerenes in the solid-state form. In particular, it addresses the structural properties, in terms of crystal structure, polymorphism, orientational transitions and morphology, and the electronic structure and derived properties, such as chemical activity, electrical conduction mechanisms, optical properties, heat conduction and magnetism. The last two sections of the review focus on the solid-state optoelectronic and electrochemical applications of fullerene derivatives, which range from photovoltaic cells to field-effect transistors and photodetectors on one hand, to electron-beam resists, electrolytes and energy storage on the other.

c) **Carbon Nanostructures Containing Polyhedral Oligomeric Silsesquioxanes (POSS)**, by *Georgia Potsi, Andreas Rossos, Antonios Kouloumpis, Myrsini Antoniou, Konstantinos Spyrou, Michael A. Karakassides, Dimitrios Gournis, and Petra Rudolf*: This mini review describes the synthesis and properties of carbon nanostructures containing organic-inorganic cage-like polyhedral oligomeric silsesquioxanes (POSS) nanoparticles. The physical and chemical functionalization of carbon nanomaterials such as graphene, graphene oxide, carbon nanotubes, and fullerenes with POSS towards the development of novel hybrid nanostructures is described in detail. Special emphasis is given to the potential impact of these hybrid nanostructures on various technological applications.

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d) **Surface Interactions: Functionalization of Graphene Oxide and Wetting of Graphene Oxide and Graphene**, by *Oseoghaghare Okobiah, and Richard F. Reidy*: Surface interactions of graphene oxide (GO) and graphene are presented in this review. This work is intended to complement previous reviews of graphene oxide chemistry as well as detail the newest efforts in this growing field. GO holds great promise as both a starting material for 2-D materials and as a platform for chemical reactions, and in both cases potential applications for this materials continue to increase. This work seeks to highlight reactions that promote attachment of different moieties and that "tune" the surface energies of GO that may enhance local interactions.

e) **Carbon Quantum Dots: Surface Passivation and Functionalization**, by *Konstantinos Dimos*: This review deals with the promising newest carbon-based nanomaterial; Carbon Quantum Dots (CQDs). CQDs demonstrate optoelectronic properties comparable to conventional inorganic semiconductors, however are environmental friendly and benign. They possess complicated structures, particle sizes up to 10 nm and upon surface passivation and/or functionalization their optoelectronic properties are critically improved and tuned. Although there are a few recent reviews on this topic, the majority of them emphasize on CQDs applications or even the synthetic procedures followed to acquire CQDs. In contrary, this review refers in brief to the aforementioned and focuses on the surface passivation and functionalization routes and therefore the functional groups and heteroatoms used for the development of high quality CQDs. Introduction and doping with appropriate heteroatoms is the key point to tailor made features of CQDs and thus organic chemistry provides the vital background for the essential functionalizations.

Finally, I want to express my appreciation to all the authors for the prosperous collaboration and their contributing reviews, to the reviewers for their critical reading of the articles which led to further improvement, and of course to the journal Current Organic Chemistry for the kind invitation to serve as a Guest Editor.

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