# Towards Multifunctional Wet Chemically Functionalized Graphene – Integration of Oligomeric, Molecular, and Particulate Building Blocks

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Many technological applications indispensable in our daily lives rely on carbon. By altering the periodic binding motifs in networks of sp3, sp2, and sp-hybridized carbon atoms, researchers have produced a wide palette of carbon allotropes. Over the past two decades the physico-chemical properties of low-dimensional nanocarbons including fullerenes (0D), carbon nanotubes (1D), and, most recently, graphene (2D) have been explored systematically.

We expect that many of the strategies that have recently been exploited and established in the context of 1D nanocarbons can be applied to the chemistry of 2D nanocarbons, especially single layer graphene. Two-dimensional nanocarbons are currently attracting extensive attention due to their striking mechanical, optical, and electrical features. Nanocarbons a single atom-thick are gapless semiconductors and exhibit electron mobilities reaching values of up to 15000 $cm^2 V^{-1} s^{-1}$ at room temperature. Researchers have made rapid progress in the covalent and / or non-covalent functionalization of single layer graphene with photo- and or redox active building blocks.

In this contribution, we summarize our work on the integration of photo- and / or redox active building blocks, including oligomers, molecules, and particulates onto graphenoid materials to yield multifunctional electron donor-acceptor conjugates and hybrids. Intriguingly, we produce graphene in the form of single layer, bilayer, and multilayer graphene through the exfoliation of graphite by surface active agents. The exfoliation occurs through π-π, hydrophobic, van der Waals, electrostatic, and charge transfer interactions, and the surface active agents also serve as versatile anchor groups. We studied the electronic interactions in terms of photo- and / or redox activity in depth by steady-state and time-resolved spectroscopy. Finally, we present examples of proof-of-principle solar energy conversion devices.