Shaping graphene oxide by electrochemistry: From foams to self-assembled molecular materials

Abstract

The ability to control the three-dimensional architecture of graphene-based materials following a rational design is essential for technological applications. Here we demonstrate that the electrochemical etching can be used as a surgical tool to tailor the morphology of graphene electrodes and to impart special features, like micrometric channels and controlled mesoporosity (foams). The final materials, thanks to the high surface area, can represent a promising class of carbon-based supercapacitors. Otherwise, new materials can be prepared using a bottom-up strategy that exploits the self-assembly of the graphene oxide quantum dots produced during the electrochemical erosion. The advantages of this second approach reside not only in the possibility to downscale the control over the spatial organization as compared to the use of conventional micrometric graphene sheets, but also in the introduction of the intrinsic luminescent properties of the quantum dots in the final material. As a proof of concept we report the preparation of luminescent nanospheres by exploiting the self-organization of the graphene oxide quantum dots around frozen water nuclei.

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