Synthesis and Optical Properties of Graphene Quantum Dots

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The outstanding electronic, optical and mechanical properties of graphene strongly inspire the scientific community at both the fundamental and applicative levels. However, the key issue that needs to be addressed is the control and the modification of the electronic properties of graphene, and notably the opening of a sizable bandgap. For the last decade, a great attention has been paid to the size reduction of graphene using conventional top-down approaches (lithography and etching, thermal treatments and oxidation of bulk materials) to fabricate graphene quantum dots (GQDs)[1] or graphene nanoribbons (GNRs).[2] However, top-down approaches do not permit to manipulate the structure of the material at the atomic scale. In particular, they do not allow a sufficient control of the morphology and oxidation state of the edges, which drastically impact the properties. In order to truly control, with the required level of precision, the morphology and the composition of the materials and of its edges, the bottom-up approach is the relevant way to proceed.[3,4]

Recently, we reported on the synthesis and single photon emission properties of triangular-shaped GQDs.[5] While, this initial report focused on functionalized nanoparticles, we now turn to non-functionalized graphene quantum dots that are in terms of structure closer to real graphene. Here, we described the synthesis, the dispersion and optical properties of a series of rod-shaped particles and we studied the structure-properties relationship in these graphene quantum dots. To this end, we designed a series of GQDs with a given edge type and by changing only one parameter (one dimension, namely the length or the width – Figure 1), we expect to follow simply the evolution of the optical properties.

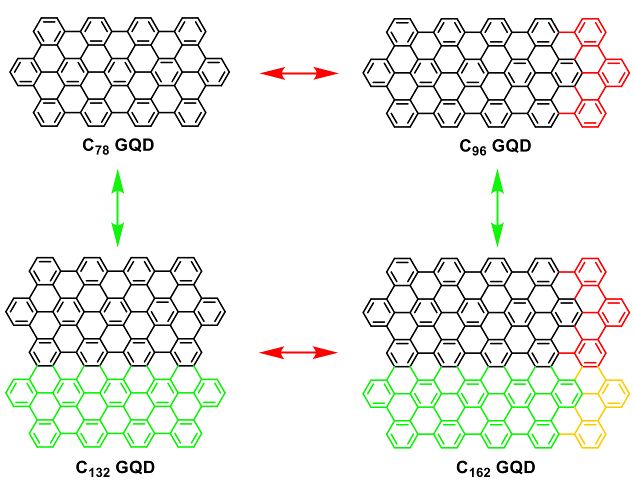

Figure 1: Structure of rod-shaped GQD designed for the study of the structure-properties relationship.

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