Synthesis and optical properties of rod-shaped graphene nanoparticles

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B05-0829 - *(Invited)* Synthesis and Optical Properties of Rod-Shaped Graphene Nanoparticles

Tuesday, 31 May 2022

20:20 - 20:40

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Abstract

The scientific community has given much interest to graphene in recent years because of its good mechanical, thermal and electrical properties. Nonetheless, applications in optics and optoelectronics can be limited due to the absence of a bandgap. In order to engineer a bandgap, we can reduce the size of graphene into graphene quantum dots (GQDs). GQDs synthesis is primarily described via top-down methods (lithography, hydrothermal and electrochemical approaches).[1] Though effective, these methods do not allow accurate control of the size, shape and edges of the GQDs. On the other hand, bottom-up graphene materials have developed exponentially for the last decade with the synthesis of highly controlled graphene nanoribbon structures and moderately soluble graphene quantum dots.[2,3] Our group demonstrated that bottom-up GQDs could act as single-photon emitters exhibiting high brightness and stability.[4]

In order to investigate the structure-property relationship, we designed a series of rod-shaped graphene nanoparticles that differ only by their length, keeping the same morphology, symmetry and edge states (see figure). These nanoparticles are fully soluble, which facilitate their purification and individualization in solution and give rise to well-defined absorption spectra. Here we report on the synthesis of these GQDs, and we will present results on advanced characterization of their optical properties.[5]

[1] Yang, J.-S., Martinez, D. A. & Chiang, W.-H. Synthesis, Characterization and Applications of Graphene Quantum Dots in *Recent Trends in Nanomaterials: Synthesis and Properties*, Khan, Z. H., Springer Singapore, (2017).

[2] Narita, A., Wang, X.-Y., Feng, X. & Müllen, K. New advances in nanographene chemistry. *Chem. Soc. Rev.* **44**, 6616–6643 (2015).

[3] Wang, X.-Y., Yao, X. & Müllen, K. Polycyclic aromatic hydrocarbons in the graphene era. *Sci. China Chem.* **62**, 1099–1144 (2019)

[4] Zhao, S. *et al.* Single photon emission from graphene quantum dots at room temperature. *Nat. Commun.* **9,** 3470 (2018).

[5] D. Medina-Lopez *et al.*, submitted

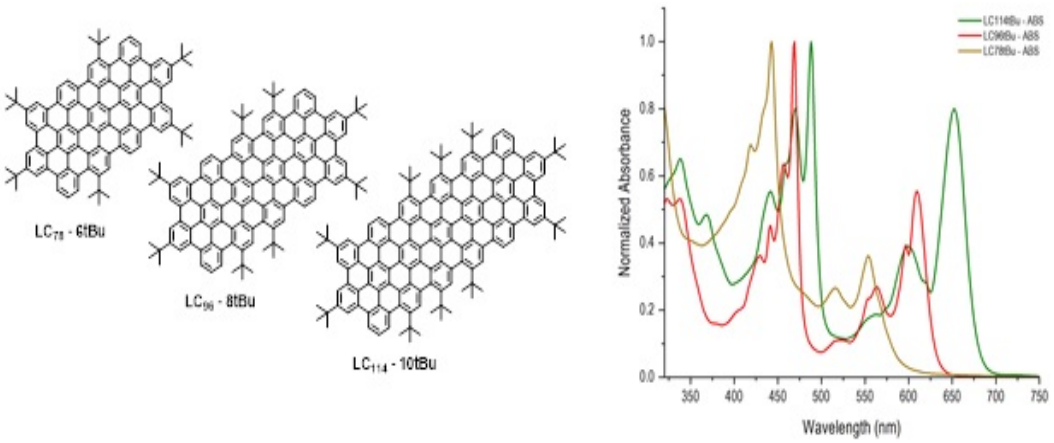

Figure 1: Structures and absorption spectra of rod-shaped GQDs: LC_{78} - 6t-Bu (yellow), LC_{96} - 8t-Bu (red) and LC_{114} - 10t-Bu (green).

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