



HAL
open science

Synthesis and properties of "bottom-up" Graphene Quantum Dots (GQD)

S. Campidelli

► **To cite this version:**

S. Campidelli. Synthesis and properties of "bottom-up" Graphene Quantum Dots (GQD). EMCMRE-6 - 6th Euro-Mediterranean Conference on Materials and Renewable Energies, Jun 2022, Marrakech, Morocco. cea-03705878

HAL Id: cea-03705878

<https://hal-cea.archives-ouvertes.fr/cea-03705878>

Submitted on 27 Jun 2022

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Synthesis and properties of “bottom-up” Graphene Quantum Dots (GQD)

S. CAMPIDELLI,

LICSEN, CEA, CNRS, Université Paris-Saclay, CEA Saclay 91191 Gif-sur-Yvette Cedex, France.

E-mail : stephane.campidelli@cea.fr

Abstract:

Despite its outstanding electronic, optical and mechanical properties, the use of graphene for real-world applications is severely limited because of its semi-metallic character. It is well known that when a material is reduced to nanoscale dimensions, the electronic confinement induces original size-dependent properties. 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, the “top-down” approaches do not allow a sufficient control of the structure of the material and of the oxidation state of the edges, which drastically affect 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}

Here, I'll present the “bottom-up” synthesis of graphene quantum dots and the first investigation of the photoluminescence (PL) properties of at the single molecular-scale. The GQDs exhibited emission of single photons at room temperature with high brightness and purity.⁵⁻⁷ Beyond this first demonstration, our interest deals with the study of the structure-property relationship in GQDs and how the size, the symmetry of the particles will permit to tune the emission properties and finally be able to perform reverse engineering to design GQD with tailor-made properties.

References:

¹ Bacon, M.; Bradley, S. J.; Nann, T. *Part. Part. Syst. Charact.* **2014**, *31*, 415-428.

² Xu, W.; Lee, T.-W. *Mater. Horiz.* **2016**, *3*, 186-207.

³ Wu, J.; Pisula, W.; Müllen, K. *Chem. Rev.* **2007**, *107*, 718-747.

⁴ Narita, A.; Wang, X. Y.; Feng, X.; Müllen, K. *Chem. Soc. Rev.* **2015**, *44*, 6616-6643.

⁵ Zhao, S.; Lavie, J.; Rondin, L.; Orcin-Chaix, L.; Diederichs, C.; Roussignol, P.; Chassagneux, Y.; Voisin, C.; Müllen, K.; Narita, A.; Campidelli, S.; Lauret, J.-S. *Nat. Commun.* **2018**, *9*, 3470.

⁶ Liu, T.; Tonnelé, C.; Zhao, S.; Rondin, L.; Elias, C.; Medina-Lopez, D.; Okuno, H.; Narita, A.; Chassagneux, Y.; Voisin, C.; Campidelli, S.; Beljonne, D.; Lauret, J.-S. *Nanoscale* **2022**, *14*, 3826-3833.

⁷ Liu, T.; Carles, B.; Elias, C.; Tonnelé, C.; Medina-Lopez, D.; Narita, A.; Chassagneux, Y.; Voisin, C.; Beljonne, D.; Campidelli, S.; Rondin, L.; Lauret, J.-S. *J. Chem. Phys.* **2022**, *156*, 104302.