CAPPIM : CARBON DOTS AS PHOTOINITIATORS FOR POLYMERIZATION IN INNOVATIVE MATERIALS

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Carbon-based nanomaterials, and more specifically carbon dots (CDs), are attracting increasing interest in the fields of materials science, chemistry, and photonics. These quasi-spherical nanostructures, characterized by their small size (less than 10 nm) and surface rich in functional groups, have a good chemical stability, a low toxicity and exhibit remarkable optical, photochemical, and electrochemical properties, making them highly attractive in various applications like bioimaging, [1, 2] sensing [3], photocalysis [4]...

In this Ph.D. project, we propose to study the **photochemical and electrochemical properties of CDs** to develop **highly efficient photoinitiating system** for **polymer material**. This approach, still not widely explored, [5] could not only broaden the horizons of CDs applications but also contribute to significant advances in the manufacturing of high-performance polymer materials.

This project will be structured around the following axes:

1. **Design, synthesis, and modification of carbon dots**: synthesis of CDs with tailored optical and electrochemical properties (visible light absorption, high luminescence yields, long lifetimes, low and/or tunable redox potential, etc.);

2. **Optimization of photoinitiating systems**: i.e. nature and concentration of photoinitiator and coinitiator contents and evaluation of their performance towards photopolymerization (radical and/or cationic) kinetics and yields;

3. **Study of photochemical mechanisms**: Analysis of the the physico-chemical and electronic phenomena at the molecular and nanostructure scale, of the reactivity of CDs such as radical generation, formation of photoinduced intermediates;

4. **Development of advanced polymer materials**: using CDs photoinitiator systems to the synthesis of functional polymers such as additive manufacturing in DLP systems [6], towards high end tomographic printing, electrospining for example.

By combining an experimental and theoretical approach, this project aims to lay the groundwork for a better understanding of the value of carbon dots as multifunctional agents while paving the way for new applications in materials chemistry and additive manufacturing.

Profile: Ideal PhD candidates should hold a Master's degree (M2) in chemistry, physical-chemistry, materials science, or a related field. A background in photochemistry, electrochemical analysis and polymer science being advantageous. Candidates should be innovative, able to work independently and collaboratively.

The application process: candidates should send a detailed CV (contact details of referees is welcome), with a covering letter to christian.ley@uha.fr, anne-sophie.schuller@uha.fr, and ariana.villarroel-marquez@uha.fr.0 Please note that the recruitment process will include a public audition in front of the Doctoral School Council.

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[3] X. Sun, Y. Lei, Fluorescent carbon dots and their sensing applications, TrAC Trends in Analytical Chemistry, 89 (2017) 163-180.
[4] X. Luo, Y. Zhai, P. Wang, B. Tian, S. Liu, J. Li, C. Yang, V. Strehmel, S. Li, K. Matyjaszewski, G. Yilmaz, B. Strehmel, Z. Chen, Light-Mediated Polymerization Catalyzed by Carbon Nanomaterials, Angewandte Chemie International Edition, 63 (2024) e202316431.
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[6] D. Krok, W. Tomal, A.J. Knight, A.I. Tartakovskii, N.T.H. Farr, W. Kasprzyk, J. Ortyl, Highly efficient carbon dot-based photoinitiating systems for 3D-VAT printing, Polym. Chem., 14 (2023) 4429-4444.