

PhD Project starting 1st October 2026

Perylenediimide-Based Platform as Light-Activated Agents for Anticancer Therapy and Imaging

Location: **Laboratory MOLTECH-Anjou, University of ANGERS**

Supervisor: **Pr. Piérick HUDHOMME**

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Project description:

Cancer treatment still remains limited by poor drug selectivity, severe systemic toxicity, and insufficient therapeutic efficacy. Light-activated nanotherapies, particularly photodynamic therapy (PDT) and photothermal therapy (PTT), offer powerful alternatives by enabling controlled tumor destruction through reactive oxygen species (ROS) generation or localized heat production.¹ However, most clinically used photosensitizers, such as porphyrins, suffer from low photostability, weak absorption in the therapeutic window, limited ROS yields, prolonged skin photosensitivity, and often rely on heavy metals (Ru, Ir, Pt) to improve photodynamic efficiency, raising concerns about toxicity and biodegradability.²

This PhD project lies at the interface of organic chemistry, polymer science and nanomedicine, aiming to develop innovative and safe photoactivated nanotherapies for cancer treatment. The PhD student will work on the development of a new class of heavy-atom-free photosensitizers and photothermal agents,³ which combine efficient singlet oxygen generation and photothermal conversion with excellent photostability and strong visible/near-infrared absorption, without the use of toxic heavy metals. We recently demonstrated the efficiency of thionated perylenediimides (thio-PDIs) as new efficient photosensitizers for PDT.^{4,5,6,7} The synthesized chromophores will be encapsulated into lipid nanocapsules or polymeric micelles stabilized by next-generation poly(2-oxazolines) (POx), offering superior biocompatibility, stealth behavior, and modular functionality compared to polyethyleneglycol (PEG)-based systems. This multidisciplinary project will provide advanced training in molecular synthesis, nanocarrier engineering, photophysical characterization, and biological *in vitro* and *in vivo* evaluation of this new class of photosensitizers and photothermal agents.

Profile of the candidate: Applicants must hold a Master's degree in Chemistry at the starting date of the PhD (1st October 2026). The ideal candidate should have a strong interest in **organic chemistry** and solid training in synthetic methodologies. The project involves both small-molecule organic synthesis and polymer synthesis and characterization. Therefore, prior experience in polymer chemistry and standard physicochemical characterization techniques will be considered an asset. Basic knowledge of photochemistry and biology is desirable but not mandatory. The candidate should be rigorous, meticulous, and intellectually curious, and able to work independently while thriving in a multidisciplinary research environment. Good communication skills, both written and oral, are required to interact effectively with researchers from different scientific backgrounds.

For more information, please contact: pietrick.hudhomme@univ-angers.fr

Candidature avant le 17 Mai 2026 sur la plateforme Amethis: [Projets de recherche doctoraux : Plateforme à base de pérylènediimide comme agents photoactivés pour la thérapie anticancéreuse et l'imagerie](#)

¹ Henderson, B. W.; Dougherty, T. J., How does photodynamic therapy work? *Photochem. Photobiol.* **1992**, *55* (1), 145-157.

² O'Connor, A. E.; Gallagher, W. M.; Byrne, A. T., Porphyrin and nonporphyrin photosensitizers in oncology: preclinical and clinical advances in photodynamic therapy. *Photochem. Photobiol.* **2009**, *85* (5), 1053-1074.

³ Zhang, X.; Wang, Z.; Hou, Y.; Yan, Y.; Zhao, J.; Dick, B., Recent development of heavy-atom-free triplet photosensitizers: molecular structure design, photophysics and application. *J. Mater. Chem. C* **2021**, *9* (36), 11944-11973.

⁴ Krupka, O.; Hudhomme, P., Recent Advances in Applications of Fluorescent Perylenediimide and Perylenemonoimide Dyes in Bioimaging, Photothermal and Photodynamic Therapy. *Int. J. Mol. Sci.* **2023**, *24* (7).

⁵ Kharchenko, O.; Gouju, J.; Verdu, I.; Bastiat, G.; Hudhomme, P.; Passirani, C.; Saulnier, P.; Krupka, O., Heavy-Atom-Free Photosensitizer-Loaded Lipid Nanocapsules for Photodynamic Therapy. *ACS Appl. Bio Mater.* **2025**, *8* (4), 3086-3095.

⁶ Kharchenko, O.; Hryniuk, A.; Krupka, O.; Hudhomme, P., Synthesis of Thionated Perylenediimides: State of the Art and First Investigations of an Alternative to Lawesson's Reagent. *Molecules* **2024**, *29* (11), 2538.

⁷ Hudhomme, P., Giving a second life to Curphey's reagent. *J. Org. Chem.* **2025**, *90*(49), 17314-17321