PhD Position in Chemistry/Chemical Biology

Design, synthesis and characterization of new rotaxanes/photosensitizers architectures for antibacterial photodynamic therapy (diagnostic and therapy).

Starting date: 1st october 2026.
Duration : 3 years (september 30, 2029)
Workplace : Université de Limoges, Laboratoire LABCiS, Faculté des Sciences et Techniques, 123 avenue Albert Thomas 87000 Limoges https://www.unilim.fr/labcis/
Funding: French National Research Agency (ANR) (Switdream project)
Type of contrat: CDD
Salary: according to the current grids (University of Limoges)
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Context

Chronic wound infection represents a worldwide problem of public health. Besides leading to frequent delay in wound healing, infected wounds are responsible for considerable morbidity and mortality and are associated with increasing healthcare costs. The emergence of MultiDrug Resistant (MDR) bacteria renders the management of infected chronic wounds ever more challenging. Moreover, evidences suggest that bacterial biofilm play significant roles in the inability of chronic wounds to heal. The emerging ineffectiveness of regular treatments has promoted the study of other strategies which would be able to reduce the impact of microbial infections. Around the world, laboratories are turning their attention towards a recent and promising alternative to antibiotics (in particular for the treatment of superficial infections), namely photodynamic antimicrobial chemotherapy (PACT). Thus, Switdream project (ANR funding) is a consortium of renowned chemists and microbiologists from CEISAM Laboratory (Nantes University) and LABCiS Laboratory from Limoges University, whose purpose is to develop a new targeted, light-activated treatment for antibacterial application.

Research project

Our objectives are the design, synthesis and thorough biophysical and biological studies of a generation of new architectures based on rotaxane/photosensitisers like Bodipy. The design of the photosensitisers will ensure reactive oxygen species (ROS) generation under near visible photoactivation to treat bacteria. In parallel and in order to increase specific selectivity of antibacterial agents, we propose to introduce cationic functions and /or vectorization agents in order to specific target Gram + and Gram – bacteria vs healthy cells. We therefore propose to attach malto-oligosaccharides (maltotriose and maltohexaose) which are known to target maltodextrin receptors present specifically on bacteria but not on healthy cells. These rotaxanes will be characterized (NMR, Mass, UV-Visible, IR,singlet oxygen yield…).The best rotaxanes (high yield of $^1O_2$, stability…) will be investigated in aPDT (antimicrobial evaluation).

The methodology will be divided in four steps: (1) synthesis of rotaxane/Bodipy complexes; (2) complexification with a cationic and/or oligosaccharide agents; (3) characterizations (NMR, Mass spectrometry, photophysical analysis, etc.) (4) biological evaluations (antimicrobial assays on bacterial strains E. Coli, S. aureus…).

Candidate profile

We are looking for a candidate holding a Master's degree in Chemistry with strong skills in organic chemistry. Good knowledge of standard purification and structural analysis techniques is required. The candidate should be curious, open-minded, and capable of learning new synthetic methods and characterization techniques. High motivation to work on an interdisciplinary project at the interface of chemistry and biology is essential.

The candidate should also demonstrate the ability to conduct independent research, as well as strong organizational skills. Proficiency in written and spoken English is required. Good english written and oral communication skills are mandatory.

Host Laboratory

LABCiS UR 22722 and in particular his research group on "Chemistry of natural molecules" (https://www.unilim.fr/labcis/) has extensive experience in the design of photosensitisers for anticancer and antimicrobial PDT (Le Guern et al. *Bioconjugate Chemistry* **2017,** 28, 2493; Le Guern et *al. ACS Medicinal Chemistry letters* (**2018**), 9, 12; Bouramatane, S. et *al*. *Carbohydrate polymers* (**2019**) *213*, 168, Godard, J. et *al.* *ACS Omega* (**2020**) 5, 43, 28264-28272, Godard, J. et al. *Colloids and surfaces: A physicochemical and Engineering Aspect* (**2021**) 612, 125988; Elkihel, A. et *al*. *ACS Applied Bio Materials* (**2021**), 4, 7204; Gresh, N. et *al*. *ChemPhysChem* (**2024**), *25*, e202300776; G. Sambucari et al. *Advanced Optical Materials*, 13, 2403076 (**2025)**)

Application: Link for submit :
https://adum.fr/as/ed/voirproposition.pl?langue=&site=unilimBCS&matricule_prop=72576

If you have any questions, contact :
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Application review will begin immediately and will continue until 15/05/2026

Le projet sera réalisé au sein du laboratoire LABCiS de l 'université de Limoges qui est un laboratoire pluridisciplinaire (Chimie et Biologie) et dont l'une de ces thématiques est le développement de Photosensibilisateurs pour des applications en Photothérapie Dynamique antibactériennes. Le/la doctorant(e) travaillera au sein du thème 2 « Chimie des Molécules Naturelles » sous la direction du Pr Vincent Sol et du Dr Frédérique Brégier Maitre de Conférences. Cette équipe bénéficie d'une expertise reconnue au niveau national et international en chimie organique de synthèse dans le domaine des photosensibilisateurs. Le/la doctorant(e) bénéficiera d'un environnement de recherche de haut niveau et stimulant pour mener à bien ce projet. Les tests antimicrobiens seront réalisés au sein du laboratoire sous la direction du Pr T.S. Ouk. Le laboratoire a accès en interne ou au sein des plateformes de l 'Université de Limoges au équipements nécessaires à la bonne réalisation du projet de recherche.

Le projet de thèse fait parti d'un projet ANR 'SwitDream' avec un partenariat avec le Laboratoire CEISAM de l'Université de Nantes.