PROPOSITION DE SUJET DE THESE
Campagne 2019/2020

Cible : étudiants Chinois à des thèses à l'ENS de Lyon
Diffusion : en Chine, via la plateforme du CSC
A remplir en français ou en anglais en fonction de la langue qui sera utilisée pour la thèse

Date : 26/11/2018

ECOLE DOCTORALE de Chimie

TITLE OF RESEARCH SUBJECT /TITRE DU SUJET DE RECHERCHE :
Design of chiral hybrid materials for emerging photonic devices

Research team/Equipe de recherche : Supramolecular Chemistry and Chemical Biology
http://www.ens-lyon.fr/CHIMIE/recherche/Teams/Chimie_Organique_et_Materiaux_Nanostructures

Supervisor/Directeur de thèse: Dr Laure GUY
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Lab Language/ Langue de travail: English or French

Abstract/Présentation du sujet :
Following pages

References:
Following pages

RETOURNER LE DOCUMENT A :
Direction des Affaires internationales : international.strategy@ens-lyon.fr

Design of chiral hybrid materials for emerging photonic devices

This multidisciplinary project aims at synthesizing new chiral materials from organic molecules and integrating them in optical circuits to develop very compact and sensitive chirosensors for fast measurement.

Chirality is a central property in the living world. Most of the bio-molecules (sugar, protein, DNA, hormones, plant product…) are chiral and are involved in enantioselective biological mechanisms. Therefore, controlling the chirality is extremely important in all fields having direct interaction with the living world (pharmacology, medicine, food industry, environmental pollution…). Today, the distinction between two chiral molecules is difficult and need specific expensive equipment. Whatever the method is (chromatography, NMR, chiroptical methods, …), instruments are expensive, heavy and measurements are not straightforward.

O**ur approach is related to the use of circularly polarized light as a probe of chirality**. We have reported recently an unprecedented proof of concept of propagating circularly polarized light in planar chirowaveguides (Fig. 1-a and b). This result relied on our ability to elaborate highly chiral films from modified binaphtol decorated with triethoxysilane moieties (Fig. 1-c) [1-3].

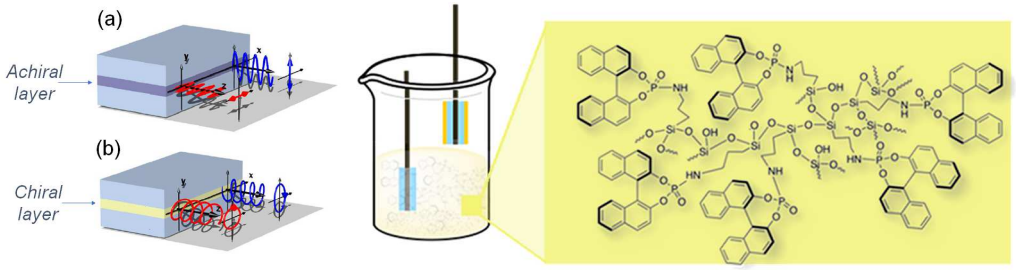

Figure 1: Planar waveguides and associated guided polarizations for a) achiral core or b) chiral core; c) Dip coating of the core layer from a home made chiral ORMOSIL. [3]

To go beyond these promising first results and to build efficient sensors, **we plan to design and synthesize new helical molecules (see Fig 2) with higher optical rotations**. From them we will elaborate patternable materials by varied polymerization techniques (sol gel chemistry, photo polymerization [4], …). Such new layers will allow the fabrication of channel waveguides for building optical circuits to develop lab-on-chip chiral biosensors.

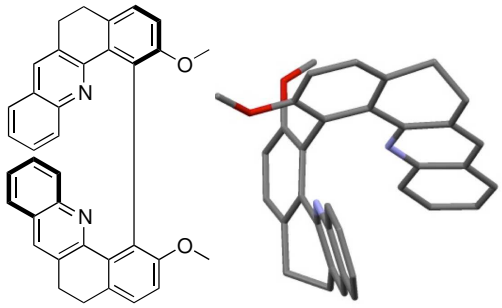

Figure 2: Example of the targeted helical skeleton (left) and the X-ray view of the same molecule (right) that have to be incorporated in materials

The candidate should principally have skills in organic synthesis, pronounced affinity for material chemistry and spectroscopic measurement. Moreover, she/he should have a strong motivation and involvement to carry out this multidisciplinary project at the interface between two laboratories (LC-ENS de Lyon and ILM Lyon).

References [1] D. Hadiouche et al, *"Optimization of optical properties of high chiral planar waveguides obtainedfrom a non-aqueous sol gel method."* Optical Materials, **2014** https://doi.org/10.1016/j.optmat.2013.12.016 [2] Amina Bensalah-Ledoux et al, *"Large-scale synthesis of helicene-like molecules for the design of enantiopure thin films with strong chiroptical activity"* Chem. A Eur. Jour., **2016** https://doi.org/10.1002/chem.201504174 [3] Stéphan Guy et al, *"Full polarization control of optical planar waveguides with chiral material."*ACS Photonics, **2017** https://doi.org/10.1021/acsphotonics.7b00975 [4] Graham R. Atkjns et al. "*Photosensitive ormosil system for integrated optics"* Optical Devices for Fiber Communication II, Proceedings of SPIE Vol. 4216 **2001** https://doi.org/10.1117/12.414110