SORBONNE UNIVERSITÉ

AAP China Scholarship Council - CSC 2024

PROJET DE RECHERCHE DOCTORALE (PRD)

Titre du PRD : Thermally Activated Delayed Fluorescence TADF (macro)molecular materials

DIRECTION de THESE

Porteuse ou porteur du projet (*doit être titulaire de l'HDR*) :

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Unité de recherche : Code (ex. UMR xxx) et Intitulé : UMR 8232 Institut Parisien de Chimie Moleculaire (IPCM)

Ecole doctorale de rattachement : ED397 - Physique et Chimie des Matériaux

Nombre de doctorants actuellement encadrés : 2

CO-DIRECTION de THESE (HDR) ou CO-ENCADREMENT (Non HDR) :

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Unité de recherche : Code (ex. UMR xxx) et Intitulé : UMR 8232 Institut Parisien de Chimie Moleculaire (IPCM)

Ecole doctorale de rattachement Sorbonne Université : ED397 - Physique et Chimie des Matériaux ou autre :

Nombre de doctorants actuellement encadrés : 1

CO-TUTELLE INTERNATIONALE envisagée : ☐ OUI ☐ NON

DESCRIPTIF du PRD :

Ce texte sera affiché en ligne à destination des candidates et candidats chinois : il ne doit pas excéder ***2 pages*** *doit être rédigé en* ***ANGLAIS***

1) Context of the study

Since the first evidence of high-performance organic light-emitting diodes (OLEDs) based on thermally activated delayed fluorescent (TADF) molecules in 2012,[1] the development of novel TADF emitters represents an active research area in the field of organic materials and OLEDs.[2] The mechanism of TADF emission is based on an up-conversion from triplets to singlets using thermal energy, which enables the triplets to contribute to the electroluminescence without need of using rare and expensive heavy metals as it is the case for phosphorescent materials. The most successful design proposed so far is based on the introduction of electron donor and acceptor moieties in light-emitting molecular structures in a "twisted" configuration to decrease the overlap between the LUMO and the HOMO electronic distribution.

Based on this molecular engineering concept, a large variety of TADF molecules has been reported in the last decade in the litterature and these materials were successfully used in emitting devices with efficiencies equivalent to those achieved with phosphorescent emitters.

More recently an alternative design based on through space donor-acceptor interactions was emerged in parallel to the "twisted approach", leading also to TADF properties and short fluorescence lifetimes. These materials were then successfully utilized to fabricate TADF OLEDs presenting generally small efficiency roll-offs.

2) Details of the proposal

As a consequence, during this PhD we aim to design and characterize a set of (macro)molecular TADF derivatives based on through space architectures developed in our group such as cyclophane cores[3] or side-chain polymers[4] in which the donor and acceptor moieties can be maintained close to each other to generate TADF activity.

These architectures will allow i) to perform a fondamental study of the through space donor-acceptor interactions leading to TADF properties and ii) to prepare new TADF materials in view of the elaboration of evaporated or solution-processed emitting devices. The traineeship will contain the following tasks: (1) the synthesis, purification and chemical characterization of a series of light emitting molecules or polymers (NMR, HRMASS, GPC, Maldi-TOF), (2) the study of their optical properties (UV-Visible, photoluminescence, CPL, and time-resolved spectroscopy), (3) the characterization of their electroluminescence properties in collaboration with national/international partners, and (4) the investigation of the relationship between chemical structure and photophysic properties in solid state particularly.

This work will be supervised by Drs. F. Mathevet and L. Sosa Vargas from IPCM, and part of the characterizations (advanced photophysics, preliminary test in device configuration) will be done in collaboration with the group of Pr. Adachi (OPERA institute, Kyushu University, Fukuoka, Japan), in the scope of an international collaboration between IPCM-SU and OPERA-KU.

3) References

[1] H. Uoyama, et al., Nature, 2012, 492, 234. [2] a) Y.Tao, et al., Adv. Mater. 2014, 26, 7931. b) C. Adachi, Jpn. J. Appl. Phys. 2014, 53, 060101. c) M. Y. Wong, et al., Adv. Mater. 2017, 29, 1605444.

[3] a) M. Auffray, et al., Chemistry – An Asian Journal, 2019, 14, 1921. b) L. Chen, et al., ACS Materials Lett. 2023, 5, 5, 1450. [4] J. Hu, et al., Angew. Chem. Int. Ed. 2019, 58, 8405.

4°) Profile of the Applicant (skills/diploma…)

Thus, we are seeking a highly motivated, curious and dynamic student with strong synthetic skills in organic and/or polymer chemistry and (ideally) photophysics. Good communication skills are required as well, especially in English, as we are a multicultural, multilingual laboratory. Note also that the student will have to interact with foreigner colleagues.

AVIS de l'Ecole Doctorale : Avis favorable

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à l'école doctorale de rattachement et à csc-su@listes.upmc.fr