



## Offre de thèse en Chimie Organique et Matériaux Moléculaires

### **Ingénierie moléculaire et cristalline pour l'élaboration de matériaux organiques luminescents à l'état solide**

### **Molecular and crystal engineering for purely organic materials emissive in the solid state**

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#### **Sujet de Thèse :**

Fluorescent and phosphorescent pure organic solids with desirable color emission and high efficiency are the target of much interests because of their potential applications in optoelectronic devices such as organic light-emitting diodes or solid-state lasers. Recently it has been realized that the emission color and the emissive efficiency in the solid state of  $\pi$ -conjugated materials are not only due to the molecular structure in the conjugated systems but are decided by the intermolecular interactions between neighboring molecules. Recent advances in aggregation-induced emission (AIE) effect have provided the importance to suppress the intrinsic and intermolecular deactivation modes that reduce the emission of conventional fluorophores.<sup>[1]</sup> Thus, it has been evidenced that emission in the solid state is enhanced by limiting the  $\pi$ -stacking of the  $\pi$ -conjugated backbone and by restricting the molecular motion via supramolecular interactions.<sup>[2]</sup> Recently some examples of efficient room temperature phosphorescence (RTP) phenomena from free metal organic derivatives have also been reported for the crystalline state of benzophenone and benzaldehyde derivatives bearing bromine atoms, thus demonstrating a possible extension of the AIE through the crystallization induced phosphorescence (CIP) concept.<sup>[3]</sup>

Recently we have demonstrated that phenylcyanovinylfuran derivatives built with pentafluorophenyl moiety presented AIE phenomena provoked by a synergistic effect of the cyano and pentafluorophenyl units.<sup>[4]</sup> We have also observed persistence of the luminescence of several seconds for new materials based on indole moiety. As a further contribution to emissive materials, the works of the thesis will be to extend AIE luminogenes for developing new series of purely organic compounds presenting high luminescence property in the solid state by aiming delayed fluorescence or RTP phenomena.

### **Compétences souhaitées :**

Chimie organique : Synthèse, purification, caractérisation. Spectroscopie : RMN, UV-vis-NIR absorption et émission.

Systèmes conjugués : Propriétés électroniques, applications des semi-conducteurs organiques.

Cristallographie : Technique de cristallisation de molécules organiques, Bases de la diffraction des RX.

**Candidature** : Toute candidature sera à effectuer par le site de l'Université Bretagne Loire (UBL) : <https://theses.u-bretagne Loire.fr/3m/>

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- [3] a) W. Z. Yuan, X. Y. Shen, H. Zhao, J. W. Y. Lam, L. Tang, P. Lu, C. Wang, Y. Liu, Z. Wang, Q. Zheng, J. Z. Sun, Y. Ma, B. Z. Tang, *The Journal of Physical Chemistry C* **2010**, *114*, 6090-6099; b) Y. Gong, G. Chen, Q. Peng, W. Z. Yuan, Y. Xie, S. Li, Y. Zhang, B. Z. Tang, *Advanced Materials* **2015**, *27*, 6195-6201; c) S. Hirata, *Advanced Optical Materials* **2017**, *5*, 1700116-n/a.
- [4] a) C. Mallet, C. Moussallem, A. Faurie, M. Allain, F. Gohier, W. G. Skene, P. Frère, *Chemistry – A European Journal* **2015**, *21*, 7944-7953; b) A. Faurie, C. Mallet, M. Allain, W. G. Skene, P. Frere, *New Journal of Chemistry* **2016**, *40*, 6728-6734.