Spécialité de Master « Optique, Matière, Paris »

Stage de recherche (4 mois minimum, à partir de début mars)

Proposition de stage (ne pas dépasser 1 page)

Date de la proposition : 6 novembre 2017

Responsable du stage / *internship supervisor*:			
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Code d'identification : LAC - UMR 9188		Organisme : ENS Paris-Saclay / PSud/ CNRS	
Site Internet / *web site*: http://www.lac.u-psud.fr/			
Adresse / *address:* bâtiment 505, Campus d'Orsay, 91405 ORSAY			
Lieu du stage / *internship place*: LAC			

Titre du stage / *internship title*: **Hybrid perovskite based lasers**

Since 2012, the hybrid organic perovskites HOP of chemical formula $(RNH_3)_2(CH_3NH_3)_{m-1}Pb_mX_{3m+1}$ (R: organic group, X: halogen) represents a "material breakthrough", particularly for photovoltaics: in only 3 years, the efficiency of HOP based solar cells has progressed from 12% to 22%. Several decisive properties of this material explain this spectacular breakthrough: good ambipolar transport properties, mobilities as high as several10 $cm^2.V^{-1}.s^{-1}$, large diffusion lengths of the carriers of the order of mm, a bandgap tuning easily performed by substitution of X or modification of the composition (*m* parameter). Since 2014, it appears that the properties of the HOP are very interesting also for light emitting devices because HOP combine strengths of the inorganic semiconductors and organic semiconductors, likely to solve the contradiction that high charge carrier mobility and large stimulated emissions are required for lasing devices. In recent studies, amplified spontaneous emission (ASE) in HOP thin layers has been demonstrated at room temperature, opening the way to HOP-based lasers and even to electrically injected lasers due to the good transport properties of this material. Additionally, these lasers will allow to address the problem of the "green gap" of the laser sources (the "green gap" refers to the fact the laser diodes emitting directly green light are rare and not performing) as a bandgap in the green range can be easily obtained by choosing the nature of X or the value of m.

However performances of the HOP-based opto-electronic devices are limited by the low crystallinity of the thin HOP layers, which affects drastically the exciton diffusion lengths and the carriers mobility. LAC team has recently developed a synthesis method to obtain monocrystalline thin layers of HOP, the "Anti-Solvant Vapor-assisted Capping Crystallisation" (AVCC method). These thin layers present a thickness of several hundreds of nm and a very large surface of several millimeters, containing practically no defects, making these thin layers good candidates to realize HOP lasers. In a first step, we will realize lasing microcavities containing these thin monocrystalline layers as the active material, the laser emission properties will be studied with pulsed and continuous optical excitation in cavity. In a second step, we will explore the possibility to realize an injected compact solid state laser source emitting directly in the green range.

In all these configurations, carrier diffusion lengths, carrier dynamics, carrier-carrier interactions, characterization of the ASE threshold, optical gain, photostability above the ASE threshold, relation between morphology and luminescence will be investigated. These studies will be performed by means of photoluminescence, micro-photoluminescence, time-resolved photoluminescence and femtosecond pump-probe spectroscopy as function of temperature.

Toutes les rubriques ci-dessous doivent obligatoirement être remplies

Ce stage pourra-t-il se prolonger en thèse ? *Possibility of a PhD* **? : OUI**

Si oui, financement de thèse envisagé/ *financial support for the PhD*: **Ecole Doctorale**

Lumière, Matière, Interactions	**x**	Lasers, Optique, Matière	**x**