Research Grants for PhD students from the China Scholarship Council

Information Form (please read the guidelines carefully on the website www-csc.utt.fr)

Supervisor's name : Steyer | Given names : Philippe

Status (prof., assistant prof., …) : Prof.

Laboratory : MATEIS | Website address : http://mateis.insa-lyon.fr/

Institution : INSA-Lyon | Website address : http://www.insa-lyon.fr

Scientific competence of the supervisor:

Philippe STEYER's research concerns the deep characterization of nanomaterials. He uses and develops then some specific electron microscopy tools (Transmission and Scanning Electron Microscopy), for better understanding correlations between the microstructure of nanometer-sized films and their macroscopic properties. He focuses his research on the dynamic realtime approach of physico-chemical damages via electron microscopies used in environmental mode. He is the head of the microscopy group of the MATEIS lab.

Two major publications in the field proposed for the PhD :

1. C. Maestre, P. Steyer, B. Toury, C. Journet, V. Garnier, Hexagonal Boron Nitride Crystal Growth in the Li3BN2-BN System, Chemistry of Materials, 36 (2024) 9848
2. L. Abou-Hamdan, … C. Maestre, C. Journet, B. Toury, V. Garnier, P. Steyer, … E. Baudin, Electroluminescence and energy transfer mediated by hyperbolic polaritons, Nature, 639 (2025) 909

Website address of the personal page : http://mateis.insa-lyon.fr/fr/content/nano-et-micro-structures

Supervisor's email : philippe.steyer@insa-lyon.fr

Description of the research work proposed for a PhD | ***Topic # (see list) :*** IV-2

Title : Better understand h-BN synthesis for its functional optimization

Subject :

2D nanomaterials offer great potential for many applications, and were the subject of many studies over the past decade. Among them, the hexagonal boron nitride (h-BN) is of particular interest, as it features a graphene-like structure and versatile electroluminescent properties. We developed a specific synthesis of h-BN crystals, from chemical reagents to a controlled crystal growth process. Today, we are able to produce h-BN samples of various morphologies: bulk, single crystals and nanosheets. The aim of the thesis is to understand the crystal growth mechanism in order to optimize the synthesis to obtain the largest defect-free pristine crystal. Crystal quality will be assessed using microscopic tools such as SEM, TEM and AFM, as well as physical properties such as cathodoluminescence. Collaborations with other French laboratories will be set up to characterize other specific properties of hBN, in particular with graphene. This thesis has a strong experimental character. To achieve its objective, the PhD student will need to understand the experimental issues involved at several scales from mm and particularly at nm. In addition, he/she will have to interact with other people, and therefore have good people skills compatible with fruitful collaboration.

Keywords :

Synthesis processes, crystal growth, Hexagonal Boron Nitride, crystal, TEM, SEM, AFM, 2D-nanomaterial, microstructural, chemical, electroluminescent, characterizations

Expected collaborations :

Laboratoire de Physique de l'Ecole Normale Supérieure (LPENS, Paris, France)
Centre Lyonnais de Microscopie (CLYM, Lyon, France),
Laboratoire des Multimatériaux et Interfaces (LMI, Lyon, France),
Laboratoire de Chimie de la Matière Condensée (LCMC, Paris),
Groupe d'Etude de la Matière Condensée (GEMAC, Versailles, france)

Background required from the applicant :

good background in materials chemistry
experience in chemical synthesis and/or in characterisation techniques listed above would be appreciated

Existence of a PDF file detailing the proposal ("yes" or "no") : yes

(see guidelines on the website www-csc.utt.fr)