

2021-2022

Proposition de stage (Master 2R ou projet de fin d'études) au LMGP

Synthesis and Characterization of MXenes with Tailored Composition

Sujet détaillé

MXenes is a young class of two-dimensional materials with a general formula of $M_nX_{n+1}T_x$, where M is an early transition metal, X is C or N, and T_x denotes to the surface terminal groups [1]. These materials have already demonstrated huge potential in many applications including energy storage, catalysis, sensors, biomedical and environmental [2]. The MSc project aims at further expanding the chemistry of MXenes by **developing a systematic optimization of their synthesis procedure** from layered $M_{n+1}AX_n$ phase precursor with different M elements (one of the choices), by tuning etching conditions appropriately (type and concentration of acids/bases, etching time and temperature). Obtained layers will be subjected to **advanced materials characterization**, in particular X-Ray diffraction, electron microscopy, and Raman spectroscopy for detailed structural and surface chemistry investigation. **Delamination of multilayered MXene structures** into single layer flakes will be done by a careful and systematic approach using large organic molecules. The morphological properties of delaminated MXene flakes will be investigated using atomic force microscopy and the best delaminated MXenes will be used to study their transport properties. The achieved results will push further ahead the detailed investigation and practical application of MXenes chemistry beyond $Ti_3C_2T_x$.

Lieu

The candidate will work at Laboratoire des Matériaux et du Génie Physique (LMGP, unité mixte Grenoble INP - CNRS) in the interdisciplinary and international Nanomaterials and Advanced Heterostructure (NanoMAT) Research Team.

Web site of the laboratory: <http://www.lmgp.grenoble-inp.fr/>

Profil & compétences requises

The desired candidate is a high school student, and/or engineering school and/or a Master 2R whose background is mainly focused on materials science, physical or inorganic chemistry. Excellent communication skills and ability to work as a member of international team as well as good oral and written skills in English language are highly appreciated. We are looking for dynamic, motivated, interested candidates with leading efforts related to experimental work to pursue a thesis.

Stage pouvant se poursuivre en thèse

Yes

Indemnité de stage

Le stagiaire sera indemnisé (~600 euros/mois).

CONTACT

Hanna Pazniak- CNRS researcher, LMGP, nanomat reseazarch group, hanna.pazniak@uni-due.de
Thierry Ouisse – University Professor, LMGP, nanomat research group, thierry.ouisse@grenoble-inp.fr

[1] Naguib, M., Barsoum, M. W., Gogotsi, Y., Ten Years of Progress in the Synthesis and Development of MXenes. *Adv. Mater.* 2021, 33, 2103393.

[2] Vahid Mohammadi, A., Rosen, J., Gogotsi Y., The World of Two-Dimensional Carbides and Nitrides (MXenes). *Science*, 2021, 332,