Internship proposal at LMGP Lab.

MXENES-GRAPHENE AEROGEL COMPOSITE FOR ELECTROCHEMICAL ENERGY STORAGE

Context

Two-dimensional MXenes (general formula is $M_{x+1}C_xT_z$, where M is an early transition metal, X is C or N, and T_z denotes to the surface terminal groups) and graphene aerogels are promising materials for next-generation electrochemical energy storage [1, 2]. MXenes exhibit high metallic conductivity and tunable surface chemistry, while graphene aerogels provide a lightweight, highly porous, and conductive 3D framework that facilitates ion and electron transport. Combining these materials offers exciting opportunities to tailor electrochemical performance through compositional and structural control.

Project description

The internship aims to design and study MXenes-graphene aerogel composites, focusing on understanding how MXenes influence the structural and electrochemical properties of the graphene aerogel in different electrolytes, with potential applications in batteries and supercapacitors. The main tasks of the internship will include: conducting a comprehensive literature review on MXenes-graphene aerogels composites; developing and optimizing fabrication routes for MXene-graphene aerogel composites with different MXene loadings and different MXene grain sizes; exploring the use of molecular bridges to enhance interfacial interaction between MXenes and graphene aerogel frameworks; characterizing the structure and morphology of the developed composites by XRD, SEM, Raman, and TEM; investigating electrochemical behavior of composites in various electrolytes through cyclic voltammetry and impedance spectroscopy.

Scientific environment

The internship will be carried out between **LMGP**, and **SYMMES,** providing a multidisciplinary environment at the interface of materials science and energy research.
The **LMGP** laboratory (Laboratory in Materials Science and Physical Engineering) is a multidisciplinary research unit located on the MINATEC site. The laboratory is dedicated to the development of functional materials for applications in the field of energy, microelectronics and health.
The **SyMMES** laboratory (Molecular Systems and Materials for Energy and Health) is part of the Interdisciplinary Research Institute of Grenoble (IRIG), within the CEA (French Alternative Energies and Atomic Energy Commission). This laboratory is dedicated to the design, synthesis, and study of innovative and original functional materials aimed at addressing societal challenges related to health, as well as energy storage and conversion.

LMGP Web Site: http://www.lmgp.grenoble-inp.fr
SYMMES Web Site: https://www.symmes.fr

Profile & requested skills

The desired candidate is a final year engineering school student and/or a Master 2 whose background is mainly focused on materials science, inorganic chemistry or electrochemistry. We are looking for dynamic, motivated candidates with excellent communication skills.

Contact

To apply, please send a CV and motivation letter to:
PAZNIAK Hanna: hanna.pazniak@grenoble-inp.fr
DUCLAIROIR Florence: florence.duclairoir@cea.fr

References

[1] Anasori, B., Lukatskaya, M. & Gogotsi, Y. 2D metal carbides and nitrides (MXenes) for energy storage. *Nat Rev Mater* **2**, 16098 (2017). https://doi.org/10.1038/natrevmats.2016.98
[2] Chen, Z., Li, H., Tian, R. *et al.* Three dimensional Graphene aerogels as binder-less, freestanding, elastic and high-performance electrodes for lithium-ion batteries. *Sci Rep* **6**, 27365 (2016). https://doi.org/10.1038/srep27365