Report on the outcomes of a Short-Term Scientific Mission[1]

Action number: CA21126

Grantee name: Fatima Zahra Bouanis

Details of the STSM

Title: Functional nanomaterials for selective gas sensors.

Start and end date: 18/06/2023 to 23/06/2023

Description of the work carried out during the STSM

- During my STSM, I visited the International Iberian Nanotechnology Laboratory (INL) renowned for its mastery of synthesis of materials for electronics applications. The objective of this visit is to strengthen the collaboration between INL, IMSE-UGE and LPICM-Ecole Polytechnique for development of new generation of gas sensors based on nanomaterials. In this subject, INL, precisely group 2D Materials, study the synthesis of 2D materials by both physical (chemical vapor deposition (CVD)) and chemical (liquid phase exfoliation (LPE)) approaches and LPICM&IMSE focuses on the characterization of these materials and the evaluation of their performances in different environment for development of gas sensors. During this visit, I carried out with group 2D materials researchers the preparation of new 2D materials like graphene, MXene, $MoSe_2$ and WS_2 using liquid phase exfoliation and chemical vapor deposition. These materials will be characterized at LPICM & IMSE using different technics such as scanning electron microscopy (SEM), atomic force microscopy (AFM), transmission electron miscopy (TEM), X-ray diffraction analysis (XRD) and Raman spectroscopy. Then, we fabricated the GFET using lithography in cleaning room and we evaluated their electrical performance by using new microprobe station developed at INL which allows to test several transistors (30-40) in a short time (less than one minute). I discussed with Dr. Bôrme the possibility of developing similar equipment for LPICM&IMSE. During this visit, I have the opportunity to discuss with the 2D materials group researchers the obtained results of MXene and MXene /graphene composite film for NO_2 detection. Also, I participated in seminar presented by Prof. Hongjie Dai from Stanford University about “Carbon-based Nanoscience”.

[1] This report is submitted by the grantee to the Action MC for approval and for claiming payment of the awarded grant. The Grant Awarding Coordinator coordinates the evaluation of this report on behalf of the Action MC and instructs the GH for payment of the Grant.

Description of the STSM main achievements and planned follow-up activities

- This STSM has on one hand to complete the electrical characterization of MXene and MXene/graphene and at other hand to discuss the obtained results of using these materials for development of gas sensors for NO_2 detection. A paper about this this subject is in preparation (the paper will be submitted at the end of July at Nanomaterials Journal).
- During this STSM I have the opportunity to discuss with Pr. Alpuim and Dr. Bôrme the creation of new joint research international team between INL, LPICM-Ecole Polytechnique and IMSE-UGE. This team will focus on the synthesis of nanomaterials for gas sensing and solar cell applications. This allow an exchange the students and researchers between the partners.
- I discussed also with Pr. Alpuim the submission of I-site project between INL, LPICM and IMSE about "Flexible gas sensors based on functionalized graphene for CO2 detection: theoretical and experimental studies" (the project was submitted and the results will be obtained at the end of July 2023).
- Discussion about to train M2 Master student or PhD student in nano-materials chemistry and modern physico-chemical characterization methods as well as computational chemistry (1 student between INL&LPICM and IMSE/year).
- Two PhD students (Elmehdi Ould Maina and Ran Li) will start thesis between INL&LPICM and IMSE (Octobert 2023 to September 2026).
- Discussion of the submission of European project (twinning Bottom-up, twining green deal …).