GENERAL INFORMATIONS

JOB TITLE: Post Doc (M/F) : Studies of Plasma-Graphene Interactions in a New Type of Reactor

WORK LOCATION: Laboratoire des Technologies de la Microélectronique (LTM) et Laboratoire de Physique Subatomique et de Cosmologie (LPSC) à Grenoble

DESIRED PUBLICATION DATE: Spring 2025

CONTRACT TYPE: Post-Doc (ANR)

CNU SECTION: 63 - 28

DURATION: 18 months

ANTICIPATED START DATE: October 2025

WORK QUOTE: Full-time

SALARY: €2,350 to €2,550 net, depending on experience

DESIRED EDUCATIONAL LEVEL: Bac + 8 (PhD)

DESIRED EXPERIENCE: 0 to 2 years after the PhD thesis

MISSIONS

The ANR project funding this postdoc began at the end of 2024 and is led by G. Cunge and M. Kogelschatz at the Laboratoire des Technologies de la Microélectronique (LTM, Grenoble) in partnership with S. Béchu from the Laboratoire de Physique Subatomique et de Cosmologie (LPSC, Grenoble) and J.P. Booth from the Laboratoire de Physique des Plasmas (LPP, Ecole Polytechnique, Palaiseau). This project aims to develop a new type of plasma reactor that would allow to control the energy of the ions impinging on the wafer in the very low energy range (between 0 and 15 eV), which is inaccessible to conventional reactors. This is essential in particular for treating ultra-fragile 2D materials. The principle is to use a “two-stage” reactor separated by a negatively biased grid. A high-density ECR plasma will be created in the upper part of the reactor above the grid: it will serve as a source of reactive radicals but also of electrons. Indeed, the most energetic electrons of this plasma will be able to cross the negatively polarized grid and generate a secondary plasma in the lower part of the reactor. This secondary plasma will have a very low electronic temperature (the electrons are not heated) and therefore a very low plasma potential and ion bombardment energy. We intend to use it to clean, dope and oxidize Graphene in a controlled manner and to reduce and dope Graphene oxides (GO). This reactor, currently under construction, will be available at LPSC in spring 2025. We will first characterize it using Langmuir probe systems and RFEA analyzers to quantify the ion flux and energy in the lower part of the reactor. In parallel, we will measure the fluxes of atomic radicals reaching the substrate by VUV absorption spectroscopy using a 1 m focal length vacuum monochromator, unique in Europe. The work will focus on the detection of H, N and O atoms, which are the most interesting radicals for modifying Graphene and its oxides. These measurements will potentially be complemented by a campaign of experiments at the SOLEIL synchrotron. The samples will be placed on a removable substrate holder (more or less distant from the grid) that can be polarized independently of the grid to control precisely the ion energy in the 0-15 eV range. The corresponding surface modifications of Graphene and GO will then be carried out at the LTM with powerful surface analysis techniques (XPS, Raman, TEM, etc…).

ACTIVITES

- Develop and use VUV absorption spectroscopy experiment at the LPSC to measure the densities of H, N, and O atoms in the secondary plasma

- Process graphene and GO samples in these plasmas and analyze them at LTM using XPS, Raman, TEM...

COMPETENCES

- Theoretical knowledge of plasma physics, plasma diagnostics, and plasma-surface interactions

- Operational know-how in plasma diagnostics and/or surface analysis

- Knowledge of LabView software (used for data acquisition) would be appreciated (but not essential)

- human skills to be able to collaborate with several research teams

WORK CONTEXT

The LTM is a joint CNRS/Université Grenoble Alpes research unit, comprising six teams, four of which are research teams, and employing approximately 90 people. The laboratory is located at the CEA-LETI site in Grenoble. At the LTM, the work will take place within the PROSPECT cluster in the plasma etching team. This team has a well-recognized expertise in etching process development and plasma/surface interactions. The individuals involved are G. Cunge (CNRS Director of Research), M. Kogelschatz (UGA professor), C. Petit-Etienne (CNRS Research engineer), and E. Despiau-Pujo (UGA professor). At the LPSC, the postdoc will also collaborate with S. Béchu (CNRS director of research), an expert in ECR plasmas and their optical and electrical diagnostics.

CONSTRAINT and RISKS

Constraint: Work on two sites (but very close since they are less than 2 km apart and accessible by tram)

Risk: NONE