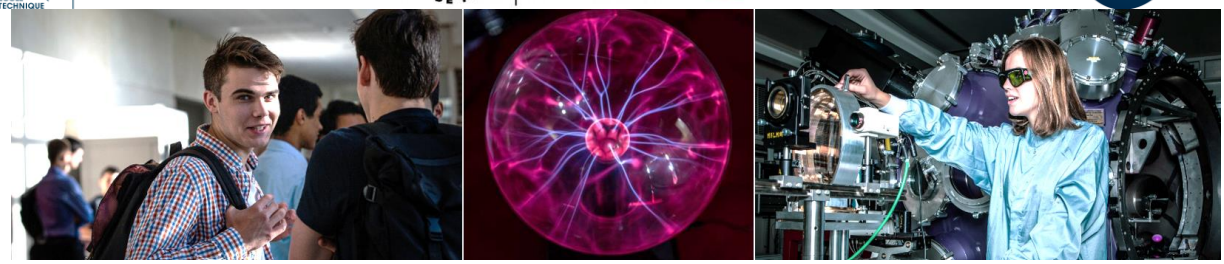

Internship proposal (Master's degree)

"Characterization and plasma deposition of III-V semiconductor thin films."

Institution	CNRS & Ecole Polytechnique, Institut Polytechnique de Paris
Laboratory	Laboratoire de Physique des Interface et des Couches Minces – LPICM
Supervisor	Dr. Karim OUARAS, karim.ouaras@polytechnique.edu
Internship Location	Ecole Polytechnique, route de Saclay, 91120 Palaiseau, France
Starting date	From January 2024
Financial support for the internship	6-months funding
Possibility of pursuing in a PhD?	Yes (trough Ecole doctorale IP Paris funding program)
Type of work	Experimental

Description

Silicon currently rules microelectronic and photovoltaic industries for many reasons, i.e., cost / optoelectronic properties ratio, well-established know-how production and knowledge acquired over many decades, with the major driving force being the low cost aspect. However, after several decades of scaling, silicon-based materials are approaching a number of limitations that have to be overcome to achieve more performant devices. Therefore, many efforts have been made in recent years to switch over other semiconductors of superior/complementary optoelectronic properties such as III-V materials (elements in rows III and V of the periodic table) but also to combine them with Silicon, so marrying the best of both worlds. However, even though III-V materials do provide extraordinary optoelectronic performances, the difficulty in processing them under complex architectures, offsets many of their advantages.

Conventionally, the epitaxial growth of III-Vs is achieved by metal-organic chemical vapor deposition (MOCVD) or molecular beam epitaxy (MBE). These methods remain expensive because of the equipment's cost and/or inefficient utilization of gases that are most of the time toxic. In addition, they operate at high temperature (usually higher than 800 °C), compromising the combination of materials having different thermal expansion coefficients.

To widen the use of III-Vs in the industry, it is therefore required to develop low-cost and eco-friendly deposition methods for growing high quality III-V thin films. Moreover, it is of great importance to have access to deposition processes that run at lower temperature to avoid as much as possible the drawback of the above-mentionned TEC mismatch issues. This could pave the way toward the direct growth of stacked monocrystalline films of different nature (hetero-epitaxial growth). This project is driven by the motivation of taking up this challenge, being a project that aims at developing a versatile, eco-friendly and low-cost approach to achieve the growth of III-V (GaN and GaAs) at low temperature (~200 °C) using a non-equilibrium plasma in physical vapor deposition (PVD) mode. Recent promising results on the growth of GaN thin films of polycrystalline nature using the plasma reactor developed at LPICM has been the first step toward this goal[1].

During 6 months and potentially pursuing after in a PhD program, the intern will take part in this exciting multi-disciplinary project by working on the optimization of the plasma deposition process for improving both the crystal quality and optoelectronic properties of GaN and/or GaAs thin films using *in-situ* plasma diagnostics (Optical Emission Spectroscopy) and *ex-situ* solid-state diagnostics (X-ray diffraction, Scanning/Transmission Electronic Microscopy, Raman, Cathodo-luminescence, ...).

Application

Your application must include:

- Cover letter explaining your motivation and highlighting your background and its relevance to the announced job.
- CV (containing a complete overview of education, supervised professional training and professional work).
- Diploma for master's degree.

For further information about the position and to apply: karim.ouaras@polytechnique.com

[1] J. Vac. Sci. Technol. A 1 September 2023; 41 (5): 053407. https://doi.org/10.1116/6.0002718