PhD offer – starting 2020/09

Remote epitaxy of III-V materials: towards low-cost high-efficiency solar cells

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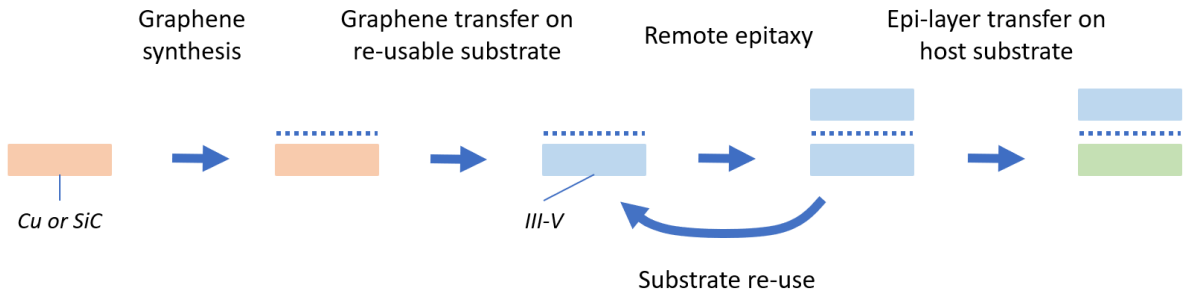
Scientific project:

Solar cells made of III-V materials present the best efficiencies among currently available technologies, up to 46% under concentration. Nevertheless, their cost is significantly higher than mainstream silicon modules. The major part of this cost, about 80% to 90%, lies in the III-V substrates necessary for the growth of monocrystalline materials with sufficient quality.

We propose to explore a new strategy to reuse the substrate for several consecutive growths, in order to drastically reduce its cost contribution. The main goal is to modify the surface of the III-V substrate, so that the fabricated III-V layers can be easily detached, leaving a clean surface suitable for subsequent layer fabrication. A promising route for surface modification, emerging in recent high impact studies and called *remote epitaxy*, consists in depositing graphene layers on top of the substrate. The complete process is depicted in the figure below.



The objectives of the PhD are twofold: (i) Define the best technological steps to achieve a high-quality *remote epitaxy*, which includes the fabrication and transfer of graphene on a III-V substrate, and the epitaxy by MBE. (ii) Elucidate the nature of the physical interactions between the fabricated material, the graphene, and the substrate underneath. It is suspected that this interaction consists in Van der Waals forces through the graphene layer. This would constitute a totally new tool for the synthesis of III-V layers, with a wealth of applications, such as photovoltaic as targeted here, but also silicon photonics, flexible devices…

This work will be done in close collaboration between the Institut Photovoltaïque d'Ile-de-France (IPVF) and the Center for Nanoscience and Nanotechnologies (C2N, SUNLIT team). It includes several methods of fabrication (graphene by CVD, III-V by MBE) and characterization (luminescence, SEM, TEM). Collaboration with high level scientists in specialized techniques are

expected. This environment gives the PhD candidate many opportunities to tackle this project challenge and gain experience.

The ideal candidate will have a master degree in physics, engineering, material sciences or related. Previous experience in clean-room is desirable but not essential. The candidate must show good organization skills to fabricate the target materials, using methods implying numerous parameters, in a clean room environment. Self-decision making and process improvement suggestions are expected. Collaborative work being at the core of the program, communication skills are required for team working as well as regular presentation of work progress in internal meetings and conferences.

Websites: https://www.ipvf.fr, https://sunlit-team.eu, https://www.c2n.universite-paris-saclay.fr