Multilayer epitaxial lift-off for low-cost III-V//Si tandem solar cells

Centre de Nanosciences et de Nanotechnologies
& Institut Photovoltaïque d'Ile-de-France, Palaiseau
Contact: stephane.collin@c2n.upsaclay.fr, jeronimo.buencuerpo@ipvf.fr

Scientific project

Solar cells made of III-V materials present the best efficiencies among currently available technologies, up to 47% 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. The reuse or multi-use of GaAs substrates is currently the main obstacle to lower the cost of III-V solar cells.

This project aims at developing of a novel device processing technique based on wet chemical etching and multi-epitaxy (several cells simultaneously). It will explore a new strategy to peel-off multiple layers selectively and one-by-one from a single substrate. It is based on an original "epitaxial-lift-off" approach, which will avoid the need of substrate reconditioning and reduces the growth dead-times of 10 different epitaxies to zero (pumping, degassing, annealing), resulting in a strong reduction of the cost of III-V solar cells.

After a training to clean-room security and processes, the candidate will prepare an experimental setup and develop the multi-layer lift-off process. The short-term goal is to demonstrate the selective, remote-controlled, sequential etching and bonding of multiple III-V layers from a single substrate (large-surface, layer-by-layer take-and-place process). The final goal of the internship will be to use this technique to fabricate a first proof-of-concept device, and to combine this new process with our recent breakthrough in the fabrication of ultrathin GaAs solar cells [1,2].

Profile

We are looking for a candidate in M2 or 3rd year of the engineering cycle, with a solid knowledge in solid-state physics, condensed-matter physics and/or physical chemistry. The candidate must show good project management skills, for the development of technological procedures involving numerous parameters. Fluent communication skills in English are required for an international team (SunLit) working as well as regular presentation of work progress in internal meetings. The candidate is expected to be able to work independently and suggest innovative solutions to reach the project objectives, and to be able to collaborate with other members of the team.

Possibility to continue with a PhD grant on high-efficiency PV in 2023.

The institute

The project is part of the IPVF scientific program on low-cost III-V solar cells, it is hosted by the SunLit team (C2N, CNRS) composed of both CNRS and IPVF researchers:
More information on the SUNLIT Team: https://sunlit-team.eu
C2N laboratory (CNRS, University Paris-Saclay): https://www.c2n.universite-paris-saclay.fr/en
IPVF: https://www.ipvf.fr, and https://www.linkedin.com/company/ipvf-institute/mycompany/

Send CV and motivation letter to: jeronimo.buencuerpo@ipvf.fr, stephane.collin@c2n.upsaclay.fr

References:

[1] H.-L. Chen et al., *A 19.9%-efficient ultrathin solar cell based on a 205-nm-thick GaAs absorber and a silver nanostructured back mirror*. Nature Energy 4, 761-767, 2019.
[2] I. Massiot, A. Cattoni, S. Collin. *Progress and prospects for ultrathin solar cells*. Nature Energy 5, 959-972,

2020.