Low-cost processes for bonded III-V//Si tandem 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 47% under concentration, and 36.1% for record III-V/Si tandem solar cells under one-sun illumination. Nevertheless, their cost is significantly higher than mainstream silicon modules. The major part of this cost lies in the III-V substrates and the epitaxial growth of monocrystalline III-V materials with sufficient quality. Our team is actively working on strategies to lower the costs: the transfer of III-V layers, the reuse of the substrate, and the reduction of the material usage using light-trapping in ultrathin solar cells [1,2].

The goal of this internship is to develop a low-cost process for the bonding of III-V//Si tandem solar cells. The team has achieved state-of-the-art results for transparent and conductive bonding of III-V//Si cells with planar interfaces. The aim of this project is to adapt this process to the bonding of cells with non-planar surfaces (rough, textured or nanopatterned). This process development will enable the implementation of nanostructures for light-trapping, and a reduction of the thickness of both III-V and Si absorbers.

After a training to clean-room security and processes, the candidate will first develop the bonding process with test, transparent samples. The short-term goal is to demonstrate the bonding of textured samples with transparent and conductive layers. The resulting test samples will be carefully characterized (optically and electrically). The final goal of the internship will be to fabricate a first proof-of-concept device made of III-V and silicon solar cells bonded together, resulting in a tandem solar cell.

Profile

We are looking for a candidate in M2 or 3rd year of the physics/engineering cycle, with a solid experience in materials science/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 2024.

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/

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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.