Characterization of next-generation tandem solar cells by luminescence

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Scientific project

Photovoltaic is playing a major role in the energy transition, and its share in electricity generation is expected to continue rising to contribute to the net zero emission goals by 2050. 90 % of the currently produced solar panels are using silicon solar cells with gradually decreasing costs and increasing efficiency. Nevertheless, this efficiency is nearing its physical limit of 29.4 %, with 26.8 % obtained in laboratory. In order to overcome this limit, the next generation of solar cells will consist in tandem devices, that combine two materials of different bandgaps. At the IPVF in particular, perovskite on silicon and III-V on silicon devices are being produced.

Those new devices present exciting challenges: new fabrication steps, new materials and combinations of materials, new aging mechanisms and failure modes… All those aspects call for a better understanding of their working principles, through new characterization methods and data analysis. We propose in this internship to take advantage of the recognized know-how of the IPVF in terms of luminescence characterization and state-of-the-art equipment.

In particular, we will develop a new technique based on simultaneous electrical and optical carrier injection in solar cells, with which we showed that we can access the current collection efficiency in each subcells, with a spatial resolution. In addition, we expect the intern to explore the feasibility of implementing those luminescence characterization methods in a LED solar simulator available in the laboratory, that provide high flexibility in the illumination spectrum.

This internship comprises an extensive part of experimental work in the laboratory as well as data treatment. We expect the intern to propose further developments of the techniques already existing at the laboratory, as well as to suggest the exploration of new methods. He / she will propose models to explain the observed phenomena, and design experiments for their validation, using his /her own knowledge as well as the scientific literature. He / she will take advantage of the unique luminescence characterization method of the IPVF as well complementary methods (solar simulator, quantum efficiency). This environment will provide the intern various opportunities to tackle this project challenge and gain experience.

The institute

The candidate will work with several members of the *sunlit* team (C2N) and "*Institut photovoltaïque d'Ile-de-France*" (IPVF). The Institut Photovoltaïque d'Île-de-France (IPVF) is a global Research, Innovation and Education center, which mission is to accelerate energy transition through science & technology. Gathering industrial PV leaders (EDF, TotalEnergies, Air Liquide, Horiba and Riber) and world-renowned academic research organizations (CNRS, Ecole Polytechnique), multi-disciplinary and international IPVF teams conduct research for clean energy technologies. Supported by the French State, IPVF is labelled Institute for Energy Transition (ITE).
Websites: https://sunlit-team.eu , https://www.c2n.universite-paris-saclay.fr/en , https://www.ipvf.fr

Profile: The candidate must possess solid knowledges in material physics and characterization. He must show good project management skills, for the development of measurement procedures involving numerous parameters. He will be able to work independently and suggest innovative solutions to reach the project objectives. 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.
Possibility to continue with a PhD grant on characterization of solar cells in 2024.
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