

Study of recombination kinetic in junctions for tandem solar cell applications

Context

In two terminal (2T) tandem solar cells, a recombination junction (RJ) connects the two sub-cells electrically in series, enabling majority carrier recombination while blocking minority carrier losses [1]. Transparent Conductive Oxides (TCOs), such as ITO, IZO or AZO are the most widely used RJ materials, typically combined with a hole or electron transport layer (e.g., ITO/NiO). Their high and tunable work function make them efficient at forming a low-resistance recombination interface with the top-cell HTL [2]. However, TCO layers introduce trade-offs: high lateral conductivity risks shunting on textured substrates, and free-carrier absorption in the near-infrared reduces bottom-cell J_{sc} . Characterizing recombination kinetics (interfacial trap density, work-function alignment, band-bending) is therefore essential to minimize V_{oc}/FF losses while preserving optical transparency. This permits to directly guide TCO thickness, doping, and interlayer engineering choices.

Project description

Within this context, the internship focuses on the study of p-n junctions with different material stacks. The characterizations are then conjointly done between the LMGP and CROMA laboratories. In LMGP, the candidate is going to explore the surface photovoltage response of the junctions using the Kelvin Probe technique under illumination [3]. In CROMA, electrical measurements will be performed to assess the diode quality and its properties.

Scientific environment:

The candidate will work in the LMGP, Materials and Physical Engineering Laboratory, in the Synfoni team in close collaboration with CROMA in the CMNE team, a specialist in characterization and electrical properties of semiconductors. Located in the heart of an exceptional scientific environment, [LMGP](#) and [CROMA](#) offer the candidate a rewarding place to work.

Profile & requested skills:

The candidate is an engineering school and / or Master 2 student whose training focuses primarily on physics of semiconductors and devices. Aptitude for teamwork, good spoken and written English will be appreciated. We are looking for a dynamic, motivated and autonomous student.

Internship allowance: Internship allowance will be provided.

Duration: 4 – 6 months.

Application Deadline: 30th December 2026

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References:

- [1] De Bastiani M, Subbiah A S, Aydin E, Isikgor F H, Allen T G and De Wolf S 2020 Recombination junctions for efficient monolithic perovskite-based tandem solar cells: physical principles, properties, processing and prospects *Mater. Horiz.* **7** 2791–809
- [2] De Vrijer T, Van Nijen D, Parasramka H, Procel Moya P A, Zhao Y, Isabella O and Smets A H M 2022 The fundamental operation mechanisms of nc-SiO $X \geq 0$:H based tunnel recombination junctions revealed *Solar Energy Materials and Solar Cells* **236** 111501
- [3] Ueda K, Fix T and Sugiyama M 2025 Direct observation of slow transient response of photovoltage for carrier dynamics in Cu(In,Ga)Se₂ via surface photovoltage measurement *Appl. Phys. Lett.* **127** 172107