

MISSION TITLE

Transport, extraction and thermalization of hot carriers

POSITION DESCRIPTION

Function	Student	Duration	4-7 months
Contract type	Internship	Education	Master / Engineering students
Starting date	From now	Salary	yes
Working Place	IPVF, 18 Bd Thomas Gobert, 91120 Palaiseau	PhD thesis	Possible, funding secured

Internship context and topic

When high energy photons are absorbed in a material, carriers are photo-generated with a large of kinetic energy above the band edge. In most cases, this excess of energy is quickly dissipated, and carriers form a quasi-thermal distribution at the lattice temperature. However, in some well-tailored devices, it is possible to slow down this relaxation such that carriers form a “hot” distribution instead. Hot carriers have a large span of consequences for the device operation and may offer a pathway to very high efficiency of solar energy conversion.

This internship takes place in the context of the UltimatePV ERC project (CNRS, Uni Freiburg, EPFL), which notably aims at fabricating a Hot Carrier Solar Cell (HCSC). While optical absorbers allowing a hot carrier population have been thoroughly investigated, the interplay with carrier transport and energy selective extraction still raises open questions.

This internship will focus on HCSC under electrical bias, at the crossroads of three complementary approaches:

- 1/ optical characterization through photoluminescence of HC absorbers under bias
- 2/ modeling of the structure to understand and interpret data
- 3/ design of samples best suited for the experiment, to be fabricated by partner labs

Building on the stronger expertise of IPVF for the analysis of hot carriers and on the dynamics of a European project, this ambitious internship combines experimental, numerical and theoretical skills to address a challenge of fundamental science in the context of disruptive energy technologies. It will be co supervised by Adam Alfieri (post doc at IPVF) and Daniel Suchet (assistant professor at Ecole Polytechnique) and immersed in the UltimatePV team (with Stéphane Collin at C2N, and Jean François Guillemoles at IPVF).

This topic is considered to be continued for a PhD project, funded by the ERC grant.

Reference :

Quantitative experimental assessment of hot carrier-enhanced solar cells at room temperature, Nguyen et al, Nat Energy 2018 (<https://www.nature.com/articles/s41560-018-0106-3>)

Influence of Hot-Carrier Extraction from a Photovoltaic Absorber: An Evaporative Approach, Suchet et al., Phys Rev Applied 2017 (<https://journals.aps.org/prapplied/abstract/10.1103/PhysRevApplied.8.034030>)

Optical determination of thermoelectric transport coefficients in a hot-carrier absorber, Vezin et al, Phys Rev Applied, 2024 (<https://journals.aps.org/prapplied/abstract/10.1103/PhysRevApplied.22.034018>)

SOUGHT PROFILE (skills will also be developed during the internship)

Knowledge	Knowhow	Self-management skills
■ Basic solar cell / semi conductor / solid state physics ■ Basic optics	■ Labwork: optics ■ Modeling: Matlab, mathematica, python or equivalent numerical tool	■ Curiosity ■ Patience

CONTACT

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