

PhD fellowship offer (36 months)

Study by frequency and temperature dependent techniques of the electrical response of photovoltaic solar cells submitted to aging stressors.

CONTEXT

The degradation of photovoltaic (PV) solar cells is caused by a number of factors that have an impact on their effectiveness, performance, and lifetime. The degradation pathways depend on the solar cell technology and on the degradation agent (light, humidity, temperature...). Understanding the degradation processes and their consequence on the solar cells electrical response is necessary to develop more reliable devices.

The PhD thesis is proposed by the Institut de Recherche de Chimie Paris (IRCP) and the Génie Électrique et Électronique de Paris Laboratory (GeePs) in the framework of the PEPR (Programme et Equipement Prioritaire de Recherche) TASE (Technologies Avancées des Systèmes Énergétiques), in the project MINOTAURE (Multimodal approach combining IN-situ, ex-situ and Operando characTerizAtion with simULations for highly Reliable next gENeration photovoltaics). This project brings together more than twenty laboratories working in the PV field. It began at the end of 2023 and will run for 5 years, with the aim of developing studies to understand and propose solutions to suppress the mechanisms of long-term photovoltaic cell degradation, in order to guarantee longer operating times.

PhD Project

The PhD thesis is proposed by the IRCP (UMR8247) and by the GeePs laboratory (UMR8507) for implementing electrical measurements on devices to get converging and complementary information on aging mechanisms. The effects of various degradation agents (light, temperature, applied bias, moisture...) on the electrical response of solar cells will be investigated by admittance spectroscopy (AS), DLTS (Deep Level Transient Spectroscopy) and impedance spectroscopy (IS). The PhD student's work will focus on various types of PV technologies: silicon heterojunction, III-V, CIGS and perovskite solar cells.

The IS spectra of the solar cells will be measured over a large frequency range in two different modes before and after aging episodes: at various applied voltages and at various light intensities. The evolution of the spectrum features upon aging will be linked to changes occurring at the interfaces and within the layers. The spectra will be analyzed using ad-hoc equivalent electrical circuits which electrical elements will be assigned to different physical/chemical phenomena and cell locations thanks to chemical/defect analyses and electrical modelling. The same solar cells will be studied by admittance and capacitance techniques. Additionally, DLTS (Deep Level Transient Spectroscopy) measurements will be performed, and the DLTS spectra will be correlated to the impedance/admittance spectra. With the comparison between this set of electrical characterization techniques, and with the support of numerical modelling that will be developed in parallel, we aim at converging interpretations and better understanding of the physico-chemical processes at hand in the

degradation of solar cells, e.g. in terms of creation of defects, presence of ions and their migration, changes in the transport across interfaces.

Required profile

The candidate must be graduated from an engineering school and/or hold a Master 2 Research diploma.

The candidate must have:

- Knowledges in Material science, Physics of semiconductors, Photovoltaics, Optoelectronics, Electrical measurements for device investigations.
- Good writing skills
- Good communication, and organizational skills.
- Interpersonal skills, problem-solving, initiative, rigor, and ability to work between two laboratories.

PhD starting : Possible from 01/10/2024

Contacts_: Dr. Thierry Pauporté (IRCP), E-mail : thierry.pauporte@chimieparistech.psl.eu.

Dr Sylvain Le Gall (GeePs/CentraleSupélec), E-mail : sylvain.legall@geeps.centralesupelec.fr,

Websites :

www.pauportegroup.com

www.geeps.centralesupelec.fr

Application procedure

For further information do not hesitate to contact us.

To apply, please send by email, to the contacts :

- A detailed Curriculum Vitae
- A cover letter explaining your motivation
- The transcript of marks obtained in Masters
- The contact details of two referees