DegradationLab

FOSS Research Centre for Sustainable Energy

ADVANCED CENTER FOR TESTING DEGRADATION AND FAILURES IN NEW AND EMERGING SOLAR CELLS

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Main Scope

- To gain a **fundamental understanding of failure development and evolution** in novel solar cell devices, and
- To **find ways to accurately, systematically, and reproducibly study** such solar cells/modules assisting in the development of appropriate **measurement protocols**.

Scientific Objectives

- The investigation of **degradation mechanisms** of different structure **perovskites and perovskites/silicon tandems** in ambient and laboratory conditions using a combination of advanced techniques.
- Addressing the **technical and scientific challenges in indoor and outdoor characterization** of perovskite-based cells.
- Investigating **carrier dynamics** and **chemical imaging** of perovskite-based solar devices **before and after degradation** in an attempt to understand carrier losses and various decomposition products.
- The **correlation between the microscopic study of failures and the performance degradation** of perovskite-based cells.

Infrastructure (indoor laboratory)

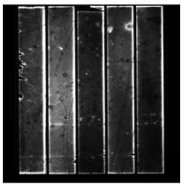
For detailed investigation of failures in new PV technologies, the new infrastructure developed at UCY enables testing from **small solar cells (0.5x0.5cm^2)** up to **mini-modules (30x30cm^2)** and is suited for **thin films** (perovskites, etc.). The systems include **high-definition cameras**, **high-spatial resolution** capability, as well as **different light excitation LEDs or lasers** to enable mapping of different junctions in tandems.

- Steady-state solar simulator for current-voltage measurements
- Spectral response and External Quantum efficiency (EQE) set-up
- Spatially-resolved Electroluminescence (EL) and Photoluminescence (PL) system
- Dark & Illuminated Lock- in Thermography (DLIT/ILIT)
- Light beam induced current (LBIC) imaging setup

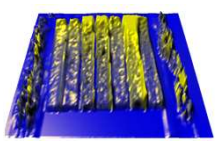
EL/PL system (Greateyes)

LBIC system (InfinityPV)

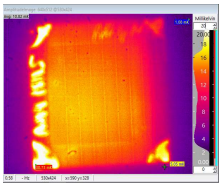
DLIT/ILIT(INFRATEC)



EL image from perovskite module

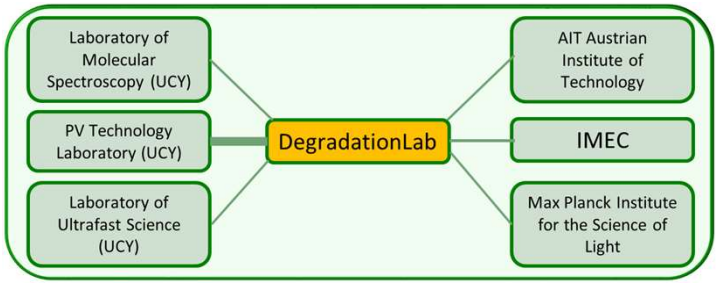


LBIC image from perovskite module



ILIT image from perovskite module

Vision & Partner network



- To develop a research hub in Cyprus for the **accurate characterization of novel solar cells and mini-modules** e.g. perovskites, tandems, kesterites, etc.
- Focus on **performance degradation**, **reliability**, **long-term stability**.
- The unit is envisaged to grow to an **integrated network of expert labs offering a complete range of scientific and technical testing solutions** both for **pure scientific research** and for **research-related services** to any interested stakeholders (academia, R&D sector, industry, and society) in Cyprus and beyond.

Infrastructure (outdoor laboratory)

A versatile outdoor cell- and module- level performance infrastructure with maximum power point (MPP) capabilities was developed enabling the following:

- Continuous monitoring of electrical parameters of test samples and respective environmental conditions. Data acquisition rate: one sample every 5 seconds or more.
- An array of modules can be tested sequentially for their I-V characteristics in different I-V sweep conditions i.e. varying voltage scan rates, open circuit or MPP operating conditions, forward or reverse bias scans and varying scan order.
- Development of accurate outdoor test protocols for perovskite and other novel PV technologies

Infrastructure (partner labs)

In addition, the following techniques at partner labs are available to cross-investigate degradation mechanisms in novel solar devices:

- Capacitance – Voltage (CV) measurements
- Ultrafast spectroscopy & time-resolved PL
- Resonant Raman spectroscopy
- Structural microscopy: TEM, SEM, XRD, EDX, etc.

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http://www.foss.ucy.ac.cy/degradationlab