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Italiadomani PIANO NAZIONALE DI RIPRESA E RESILIENZA
NEST NETWORK FOR ENERGY SUSTAINABLE TRANSITION

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International Workshop on

Solar Applications For Environment

Ecodesign and sustainability of materials, systems, technologies and processes in the energy transition

Abstract Book

Aula Capitò - Dipartimento di Ingegneria
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NEST
NETWORK FOR ENERGY SUSTAINABLE TRANSITION

Finanziato dall'Unione europea
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NEST - SPOKE 1

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Obiettivo principale dell'operazione
"Scenari energetici del futuro"

Spoke 1 aims at boosting the Photovoltaics (PV) and Concentrated Solar Power/Concentrated Solar Thermal (CSP/CST) sectors toward higher amount of renewable energy production at competitive costs, overtaking actual limits and introducing innovative research at low Technology Readiness Level (TRL).

PROBING REVERSE-BIAS EFFECTS IN WIDE-BANDGAP PEROVSKITE SOLAR CELLS USING SPECTROSCOPIC TECHNIQUES

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In the field of the green energy transition, solar technologies are experiencing rapid growth, pushing the search for materials capable of achieving higher power conversion efficiencies at lower fabrication costs. Among these, lead halide perovskites have emerged as highly promising candidates thanks to their strong optical absorption, adjustable bandgap, and cheap fabrication compared to conventional photovoltaic materials. However, the commercialization of perovskite solar cells (PSCs) is hindered by several issues, such as limited operational stability. Indeed, these devices can degrade through multiple mechanisms, including exposure to moisture or heat, photochemical reactions, and electrical stress. Focusing on the last, electrical stress—often triggered by reverse bias—can promote ion-vacancy migration within the perovskite structure, resulting in permanent structural and electronic alterations. This work examines reverse-bias-induced degradation in wide-bandgap formamidinium lead bromide ($FAPbBr_3$) PSCs. Raman spectroscopy is here employed to detect and quantify structural modifications associated with ion-vacancy migration under reverse electrical polarization. Its non-destructive nature and high spatial resolution enable the identification of subtle lattice changes linked to early-stage degradation. To further connect structural evolution with device performance, we also perform steady-state and time-resolved photoluminescence measurements.
By integrating spectroscopic observations with I-V behaviour, this study offers deeper insight into degradation pathways—particularly those initiated by electrical stress—and underscores the value of spectroscopic techniques in improving the stability and long-term reliability of perovskite solar cells.

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