ELECTRICAL, ELECTRONICS AND COMMUNICATIONS ENGINEERING

Novel architectures of silicon-based tandem solar cells

Funded By	Dipartimento DET
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Context of the research activity	With achievable efficiency above 40%, silicon-based tandem solar cells are the most promising technology for the future terrestrial photovoltaics market. The research activity will focus on the development and engineering of a new multi-terminal tandem cell architecture that borrows the elementary structure of a classic electronic device, the bipolar transistor, to achieve a simple monolithic device whose energy yield is robust to real field conditions.
Objectives	Tandem or multi-junction solar cells are a consolidated approach to high efficiency photovoltaics. They consist of different bandgap cells, stacked one on each other, to harvest the sun spectrum more efficiently than a single-gap cell. One strategy to achieve high energy-yield despite spectral fluctuations (on earth) or radiation damage (in space) is to adopt multi-terminal architectures, where the sub-cells are operated independently, instead of the more traditional series-connected two-terminal configuration. III/V semiconductor multi-junction cells are the gold standard for space and concentration applications, whilst several paths to tandems on silicon and low-cost thin-film materials are studied for terrestrial use. Recently, a new type of PV based on organometal halide perovskite (PVK) became the most efficient among thin film technologies, owing to the optimal properties of the PVK such as high absorbance, ambipolar transport, defect tolerance, low temperature processing, chemical and band tunability. PVK can be combined with silicon to realize tandem solar cells with high efficiency. In this PhD project, the candidate will be involved in research activities devoted to develop PVK/silicon tandem solar cells that use the three-terminal bipolar transistor architecture. The candidate will study these devices with physics-based simulation approaches including electromagnetics and transport. The activity will be carried out in the framework of the PRIN project CLAIRE (starting in Fall 2023), recently funded by the Ministry of University and Research (MUR).
Skills and competencies	Fundamentals of light-matter interaction and semiconductor devices;

for the development of the activity	Drift-diffusion model of semiconductors; Photonics;