LASERGRAPH: In-situ laser fabrication of graphene electrodes and interlayers for next generation CIGS/Perovskite solar cells

Main area: GRM-based tandem solar modules
Keywords: Perovskite; CIGS; tandem solar cells; in-situ laser processing; graphene based electrodes; charge dynamics;
Duration: 36 months
Total project funding: € 1.030.000

Abstract

Following decades of research, state of the art Silicon solar cells are gradually reaching their theoretical efficiency limit. An elegant way to realise even higher Photovoltaic (PV) efficiencies is to combine two semiconducting materials with matching band gaps, in tandem architecture. Owing to their exceptional optoelectronic properties, perovskites are currently in the spotlight of research and have been demonstrated to be the perfect tandem component to conventional PV technologies. In this context, tandem solar cells based on the combination of thin-film perovskite and copper indium gallium diselenide (CIGS) configurations have been developed and appear to be a promising next-generation, commercially viable, PV technology. However, the success of this approach relies strongly on the employed interlayer and transparent conductive electrode (TCE) technologies that are vital for the effective coupling of the tandem solar cells components. Indeed, today's interlayers' technology relies mainly on conductive polymers that are highly unstable, while their thickness induces parasitic absorption and limits the overall power generation. More importantly, their deposition requires methods that are hard to implement in large-scale devices without damaging the perovskite part of the device. LASERGRAPH proposes the application of in-situ laser processing schemes for the development of graphene-based interlayers and TCEs, incorporated within CIGS/Perovskite tandem PV cells. Although the benefits of using graphene-based compounds as interfacial and TCE layers within single-junction perovskite solar cells has been proven, to date such approach has not been yet explored for tandem solar cells technologies. LASEGRAPH tackles this challenge by means of the fabrication of high-performance CIGS/Perovskite cells incorporating graphene-based interlayers and TCEs, developed via in-situ, non-contact, and room temperature laser processing techniques. The proposed approach is expected to have an immediate impact on both the academia and industry, as it addresses simultaneously the two major scientific challenges that hinder the commercialization of the perovskite PV technology. Specifically, graphene-based layers are expected to improve drastically the charge carrier extraction and thus the PV efficiency, as well as to protect the sensitive perovskite absorber, giving rise to improved stability. At the same time, the LASERGRAPH approach is simple and cheap, while its in-situ, non-contact and post-fabrication nature makes it readily adoptive in industrial PV production lines.

Consortium

Emmanuel Stratakis – Foundation for Research and Technology Hellas –Greece – Funded by: GSRT
Bart Vemand – University Hasselt – Belgium – Funded by: FWO
Tom Aernouts – Interuniversity Micro-Electronics Centre – Belgium – Funded by: FWO
Ellen Moons – Karlstad University – Sweden – Funded by: VINNOVA