Engineering narrow bandgap perovskite solar cells for the absorption on the NIR using photonic crystals approach

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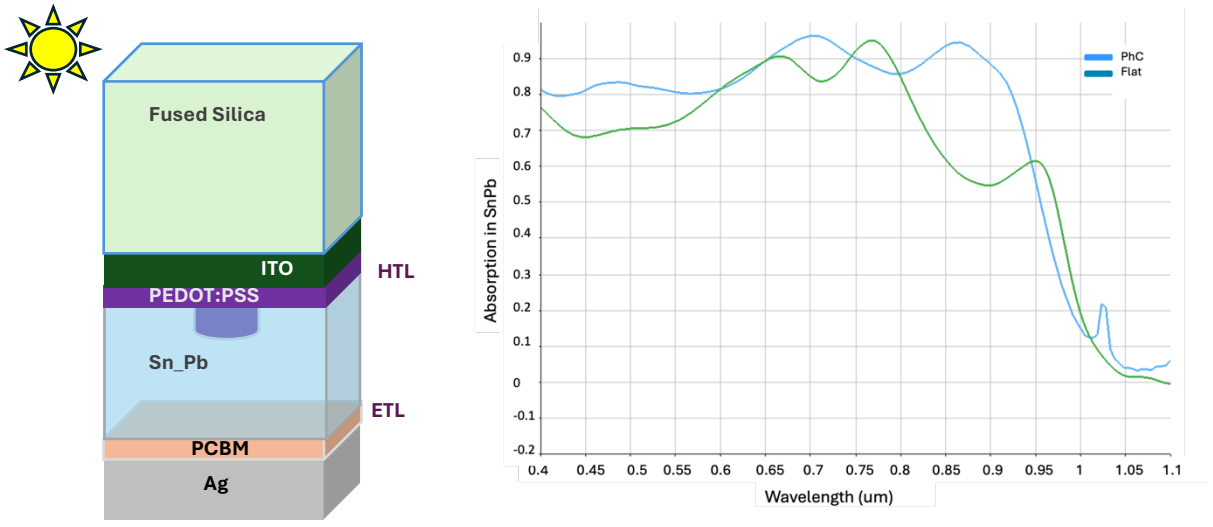
Sn-Pb perovskites in tandem cells has been use to counter the limitations on the energy payback of a tandem cell which is reduced from 1 year to just a few months[1] due to its difficulties in harvesting near-infrared photons. However, the use of Sn impacts significantly on the carrier diffusion length [2], and reducing the Sn-Pb thickness affects the achievable photocurrent for an optimal PV tandem cell. In this work, we use an optical approach by introducing photonic crystals[3] on a single Sn-Pb junction cell with the intention to improve the short circuit current while lowering the thickness of the Sn-Pb layer. Our preliminary simulation results of a p-i-n photovoltaic cell, including a photonic crystal slab in place of the HTL layer (FIgure 1.a), shows a short circuit current of around 30 mA/cm^2, calculated from its absorption spectra. This is already an improvement from its flat (non-patterned) equivalent structure with a current density of 27 mA/cm^2. The photonic crystal modes of our structure, around 0.85 and 1.03 um (figure 1.b), contribute to the increment of the photo-current. We are currently working on the simulation of different configurations of photonic crystal slabs to optimize our design.



a. b.

Figure 1. a) Example of the photovoltaic cell with a patterned HTL b) Absorption results from the patterned structure (blue line) versus the absorption on its non-patterned equivalent (green line).

Bibliography

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