# Development of semitransparent organic solar cells for Agrivoltaics

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The domain of Agrivoltaic (or AgriPV) has emerged as a promising solution to conciliate agricultural land and large-scale electricity production using photovoltaic (PV) modules. In this frame, the development of semitransparent PV modules is of particular interest since it can offer a 100% coverage without shaded areas.

Furthermore, since the absorption spectral range of organic semiconducting materials can be tuned through band gap engineering, organic solar cells have the potential to allow proper growing of plants by allowing photosynthetic wavelengths, typically between 400nm and 700nm [1], to be transmitted through the cells and the rest of spectrum to be absorbed for electricity generation.

In the frame of the SMART4MODULE* of the TASE PEPR program, we are developing semitransparent solar cells to be integrated into greenhouses for AgriPV applications. We developed a numerical model to predict the performance (production of electrical current and transparency) of semitransparent solar cells. This model is based on a S-Matrix method (PyMoosh free software [2]) and allows calculating both the electrical photocurrent generated by the semitransparent PV cells and the GrowthFactor [3] from the transmitted light spectrum to estimate the photosynthetic activities of plants growing in a greenhouse. Considering the photosynthetic response of strawberry as a model case (see figure 1 a-) [1], we used this model to optimize the solar cell architectures and to benchmark different organic semiconducting materials (see figure 1 b- and c-). The optimized cells have been fabricated and tested, and their performances have been compared to the numerical model.

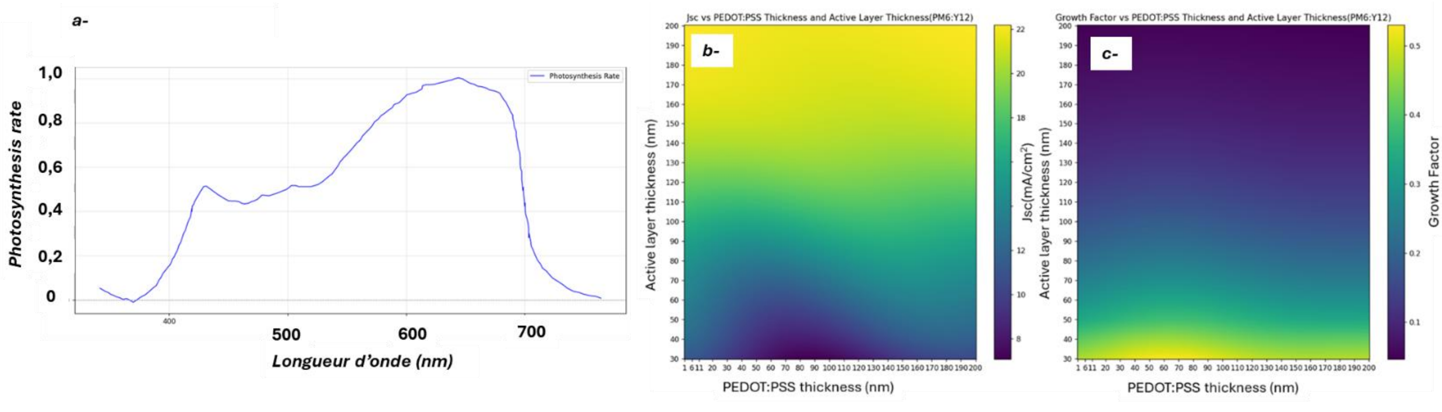


Figure 1: a- photosynthetic response of strawberry (extracted from [1]), b- and c- calculated Jsc and GrowthFactor for the following solar cell architecture: Glass/ITO/ZnO/PM6:Y12/PEDOT:PSS.

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[1] K. Inada, *Plant & Cell Physiol.* 17: 355-365 (1976)

[2] Langevin et al., 41(2), A67-A78 (2024)

[3] C. J. M. Emmott et al., Energy Environ. Sci., Issue 4 (2015)