

Roll-to-roll suitable short-pulsed laser scribing of organic photovoltaics and close-to-process characterization

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The proper long term operation of organic electronic devices like organic photovoltaics OPV depends on their resistance to environmental influences such as permeation of water vapor. Major efforts are spent to encapsulate OPV. State of the art is sandwich-like encapsulation between two ultra-barrier foils. Sandwich encapsulation faces two major disadvantages: high costs (~1/3 of total costs) and parasitic intrinsic water (sponge effects of the substrate foil).

To fight these drawbacks, a promising approach is to use the OPV substrate itself as barrier by integration of an ultrabARRIER coating, followed by alternating deposition and structuring of OPV functional layers. In effect, more functionality will be integrated into less material, and production steps are reduced in number. All processing steps must not influence the underneath barrier functionality, while all electrical functionalities must be maintained.

As most reasonable structuring tool, short and ultrashort pulsed lasers USP are used. Laser machining applies to three layers: bottom electrode made of transparent conductive materials (P1), organic photovoltaic operative stack (P2) and top electrode (P3).

In this paper, the machining of functional ~110...250 nm layers of flexible OPV by USP laser systems is presented. Main focus is on structuring without damaging the underneath ultra-barrier layer. The close-to-process machining quality characterization is performed with the analysis tool "hyperspectral imaging" (HSI), which is checked crosswise with the "gold standard" Ca-test. It is shown, that both laser machining and quality controlling, are well suitable for R2R production of OPV.

