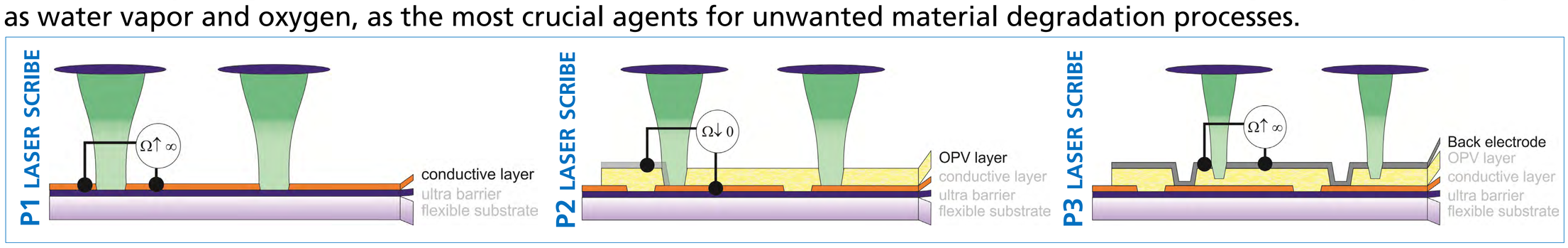
ADVANCED LASER ABLATION ON BARRIER FILMS FOR ORGANIC AND LARGE AREA ELECTRONIC DEVICES

The ALABO project has received funding from the European Union's Horizon 2020 research and innovation program under grant agreement No. 644026.

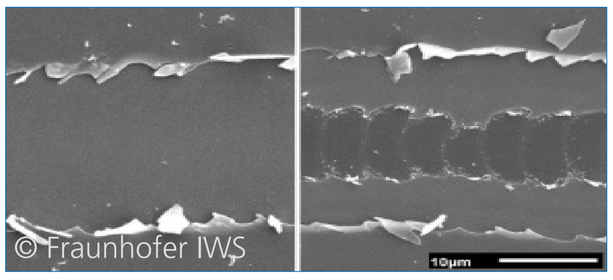
Motivation

The overall objective of this project is to develop organic electronic building elements on flexible substrates with monolithically integrated barrier foils as substrate. The barrier acts as the inevitable protection against atmospheric gases as water vapor and oxygen, as the most crucial agents for unwanted material degradation processes.

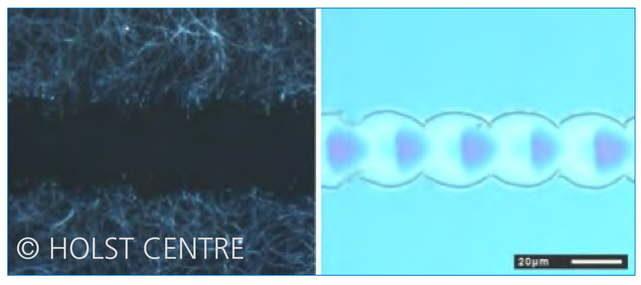


Direct laser scribing on flexible ultra-barrier foil

The developments address innovative processes for structuring the bottom electrode (**P1-scribe**) the organic layer system (**P2-scribe**) and the top electrode (**P3-scribe**) without damaging the ultra-barrier layer to guarantee the barrier performance of WVTR $\leq 10^{-5}$ g m^{-2} d^{-1}. In parallel the barrier will be further optimized regarding the requirements of their adaptation to the laser process.



SEM of femtosecond-laser machined DMD-coated P2 substrate below (left) and above (right) threshold



Nanosecond-laser machined AgNW-coated (left) and picosecond-laser machined ITO-coated (right) P1 substrates

Scale up of laser scribe processes to roll-to-roll production

The transfer of laser scribing technologies into large-area, large volume OPV production using R2R processes is high challenging. Driven by the strong need of a cost-efficient OPV production the web width increase from 300 mm to at least 1200 mm has to be considered as well as a target web speed of 5 m/s. Technologies to speed-up the laser scribing process by new speed beam deflection systems are developed to meet the R2R processing demands.

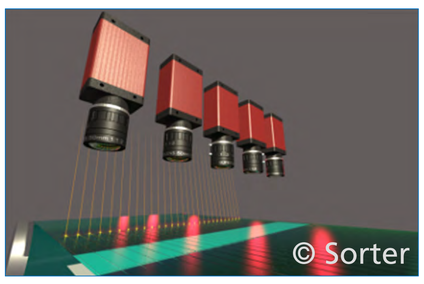
R2R equipment for manufacturing ultra-barrier webs (WVTR: 10^{-6} g m^{-2} d^{-1}) (Holst Centre)

R2R printing and laser structuring machine (3D-Micromac AG)

R2R production of HeliaFilm® (Heliatek GmbH)

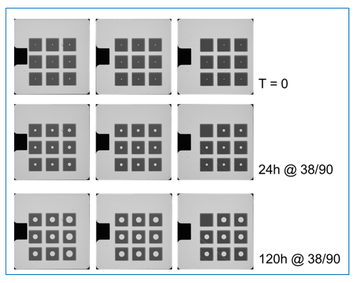
Advanced analytical and monitoring tools

The performance of the ultra-barrier are evaluated by their Water Vapor Transmission Rate (WVTR). To monitor the ablation process especially to detect the endpoint of laser treatment continuously a Laser Induced Breakdown Spectroscopic (LIBS) system is developed and tested. A fast vision system combined with a real time image processing are developed to control the scribe alignment and necessary readjustment during the R2R manufacturing.



3D visualization of camera positioning in the R2R process

Measurement of barrier webs for organic flexible electronics with WVTR up to 10^{-6} g m^{-2} d^{-1}



Ca-Test: after 2-3 days all damage of the barrier layer can be observed (Holst Centre)

Partners

Heliatek The future is light · SORTER · Holst Centre · cnrs LP3 · cea tech · Fraunhofer IWS · 3D MICROMAC

Contact

Dr. Udo Klotzbach, Fraunhofer IWS Dresden, Winterbergstraße 28, 01277 Dresden, Germany, udo.klotzbach@iws.fraunhofer.de, Phone: +49 351 83391 3252