Fraunhofer IAP

Organic Photovoltaics

The Fraunhofer IAP develops customized applications for organic photovoltaics (OPV) with the focus on material and process development for solution processing on rigid and flexible substrates. The advantages of using polymer substrates for OPV applications are light weight and flexible devices with large active areas with a potential for mass production in R2R process lines at low cost and low carbon footprint. Digital printing processes like inkjet printing enable customization in the design. Process development includes ink formulation and optimization of printing processes with respect to layer homogeneity and morphology for achieving optimized device performance. Different applications have been addressed such as textile integration for charging of mobile devices as well as different architectural applications. Examples are sustainable façade elements for building integration or the integration of flexible OPV in air-filled foil cushions for generation of energy as autarkic source e.g. for lighting or heating.

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Electrostatic jetting (ESJET)

Electrostatic (ESJET) or electrohydrodynamic jetting (EHDJET) is a new technology for printing structures with very high resolution and aspect ratio. ESJET or EHDJET lowers the resolution limit for digital printing to 1 µm. It is a method of liquid processing under ambient conditions and can thus replace more expensive microfabrication technologies. One of many possible examples is high-resolution OLED and QD-LED smartphone displays.

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Quantum Dots

Quantum dots (QDs) represent the latest generation of hybrid inorganic-organic nanomaterials. They form a triad of inorganic nanotechnology, organic semiconductor technology and solution-based processability. The emission properties of these inorganic, luminescent nanoparticles are controlled by the particle size. Fraunhofer IAP has developed several procedures for the synthesis and modification of QDs to provide very stable indium phosphide (InP) QDs covering a wide spectral range from green to red with a high quantum yield, low Full Width at Half Maximum (FWHM) and high stability in organic solvents and in polymer materials or resists. Developing the high-performance QD-LEDs based on InP-based QDs is quite important to bring QD-LEDs into the future display market. The Fraunhofer IAP investigated the performance of inverted QD-LEDs fabricated with synthesized multi-shell InP/ZnSe/ZnS QDs and ZnO nanoparticles as well. The results show that InP/ZnSe/ZnS QDs is the most promising candidate for the Cd-free QD-LEDs. The investigated QD-LEDs match the performance of CD-based QD-LEDs with luminance values higher than 25.000 cd/m^2.

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Solution processed OLEDs

The Fraunhofer Institute for Applied Polymer Research IAP develops solution processed OLEDs with a focus on device architecture, establishment of efficient printing processes and device characterization. Customized applications include, besides classical displays, ambient lighting and illuminated signages that could be integrated in automotive, white goods and textile applications. Besides large area deposition techniques, digital printing techniques such as inkjet and ESJET are the central tools for the individual design of the devices. To enable an economically efficient production also on smaller quantities, we are working on fully solvent processed devices without any vacuum deposition techniques. Custom oriented projects are offered from material testing to process development from lab scale to pilot scale. For example, in cooperation with LOMOX Ltd. we have developed a structuring process for OLEDs using their crosslinkable emitter materials to show the IAP logo.