An experimentally-validated multi-scale materials, process and device modelling & design platform enabling non-expert access to open innovation in the Organic and Large Area Electronics Industry (MUSICODE)

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Fabrication and characterization of PPV devices and model assessment

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Glossary

AFM	Atomic Force Microscopy
Ag	Silver
Al	Aluminium
AOI	Area of Interest
Ca	Calcium
DI	De-ionised water
DIT	Dark-Injection Transient
EOD	Electron Only Devices
ETL	Electron Transport Layer
FF	Fill Factor
HOD	Hole Only Devices
HTL	Hole Transport Layer
IMI	Indium Metal Indium (an ITO alternative)
ITO	Indium Tin Oxide
Jsc	Short Circuit Current
NFA	Non-Fullerene Acceptor
NW	Nano Wire
OE	Opto-Electronic
OLED	Organic Light Emitting Diode
OPV	Organic Photovoltaic
OVPD	Organic Vapor Phase Deposition
PAL	Photoactive Layer
PCE	Power Conversion Efficiency
PET	Polyethylene Terehthalane
PL	Photoluminescense
PTAA	Poly[bis(4-phenyl)(2,4,6-trimethylphenyl)amine
PPV	Perovskite Photovoltaic
R2R	Roll-To-Rolle
SCLC	Space-Charge-Limited-Current
SE	Spectroscopic Ellipsometry
Voc	Open Circuit Voltage
WP	Work Package

Contents

Publishable summary

The contents of this document refer to WP3, Fabrication and characterization of perovskite photovoltaic (PPV) devices and model assessment (M1-24) under the WP3 Model validation by analytical characterization (M1-M36) and in particular Task 3.1. Fabrication of tests OE materials and devices (M1-M30).

WP3 conducts experimental tests and characterization to validate the models of WP2. Specifically, D3.4 sets out that “3D and 3D/2D hybrid perovskite devices will be fabricated in both the regular, i.e., n-i-p and inverted, p-i- n architecture. The device fabrication is planned to be carried out using solution processable spin coating at initial level followed by scaling up via slot die coating technique. These processes will be conducted in controlled environments and the process modelled to build the predictive capability of CAD for PPV materials”. In this regard, the specifications for the substrate, cathode, transport layers, the perovskite materials, and the anode were defined in WP 1.1

This report shows the experimental work undertaken so far for D3.4 as part of Task 3.1. Small sized PPV with photoactive areas below 1 cm² were fabricated in section 3.1 by means of the spin-coating deposition technique. To achieve PCEs above 17% special attention was paid to optimize the perovskite device stack. It was shown that to achieve high PCEs, the fabrication conditions and the resulting properties of the PTAA-based hole transport layer needed optimization. Then the optimized device stack was used for the fabrication of PPV devices by means of the scalable deposition technique called “slot-die coating”. In particular, the perovskite absorber was fabricated by slot-die coating, whilst the rest of device was still deposited with the spin-coating technique. The study was also published in the *Scientific Reports* journal. In section 3.2 the scalable deposition technique called “bar coating” was used for the fabrication of devices on large-area substrates. Like previous studies, based on the spin-coating technique, in section 3.2 the bar coating technique was used to optimize the PPV device stack. The properties of the PTAA layer were studied and novel perovskite inks were developed. PCEs exceeding 17% were achieved. Additionally, the stability of the devices was investigated. Finally, in collaboration with Fluxim the optimal device layout and the resulting performance behavior of large-area PPV modules was simulated. Based on the simulations, PPV modules were fabricated and PCE above 10% were achieved for modules with a physical area of 25cm².