NFA4R2ROPV
Industrial roll-to-roll (R2R) printing of highly efficient non-fullerene acceptor (NFA)-based organic photovoltaics (OPV)

Project duration: from 09.2019 to 02.2023
Report submitted: 06.2023

Publishable Summary

Organic photovoltaics (OPVs) are based on semiconducting carbon-based materials. In OPV industry they are fabricated out of benign (green) solvents using roll-to-roll (R2R) coating or printing techniques. Their working principle differs quite significantly from standard photovoltaics (PV), as light rays are absorbed in the bulk of organic layers not at a discrete interface. This leads to strongly different key performance indicators such as a good low and diffuse light performance, angular independence and an efficiency that rises with higher temperatures.

This project brings together five world-leading partners (three from academia and two from industry) from the OPV community with the objective to demonstrate printed, large-scale, NFA-based OPV modules fabricated out of benign solvents with efficiencies well beyond the current state of the art. The consortium has the complementary expertise necessary for this project, including device design, morphology characterizations, photophysics, device physics, and large-scale printing. The availability of this broad range of expertise allowed us to achieve our objectives using both the fundamental mechanistic understanding and careful engineering of the fabrication processes.

We have identified promising donor:acceptor combinations for high-efficiency organic solar cells processed from green solvents. Based on these new materials, we have obtained power conversion efficiencies with 12% on average in case of flexible lab-sized devices using an architecture and processing conditions very close to industrial R2R manufacturing. On module level an efficiency of up to 7% has been reached for R2R slot-die coated, flexible, and semi-transparent devices manufactured on production equipment. The modules show promising photostability and first glass-laminated demonstrators have been prepared. Further an active area efficiency of 8-9% has been reached on opaque fully solution processed roll to roll processed modules on industrial production equipment. We have characterised the photophysics and morphology of green solvent processed organic solar cells. In addition, we submitted a manuscript addressing guidelines to bridge the gap between academic and industrial research on organic solar cells.

Project consortium

Coordinator and all contact details:

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Participating countries and financing:

Country	**Number of organisations involved**	**Project costs in EUR**	**Public funding in EUR**
Sweden	2	606 231	403 690
Germany	2	657 443	420 619
The Netherlands	1	625 000	410 586
Total	***5***	***1 888 674***	***1 234 895***

Funding agencies involved and contracts

Funding Agency	**Contract N° and Title**
Energimyndigheten SWEA	Contract no 48382-1 Title: Industriell rulle-till-rulle tryckning av högeffektiva ickefullerenacceptorbaserade organiska solcellsmoduler.
BMWK, PTJ	03EE1023B, NFA4R2ROPV – Industrielle Rolle-zu-Rolle-Fertigung organischer Photovoltaik auf Basis von Nicht-Fullerene-Akzeptoren 03EE1023A, Verbundvorhaben: NFA4R2ROPV – Industrielle Rolle-zu-Rolle-Fertigung organischer Photovoltaik auf Basis von Nicht-Fullerene-Akzeptoren; Teilvorhaben: Herstellung effizienter NFA-basierter OPV-Module und Demonstratoren mittels Rolle-zu-Rolle-Druck
RVO	Contract no SOL18005 Title: Industrial roll-to-roll (R2R) printing of highly efficient non-fullerene acceptor (NFA)-based organic photovoltaics (OPV) (NFA4R2ROPV)