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Advances in organic solar cells

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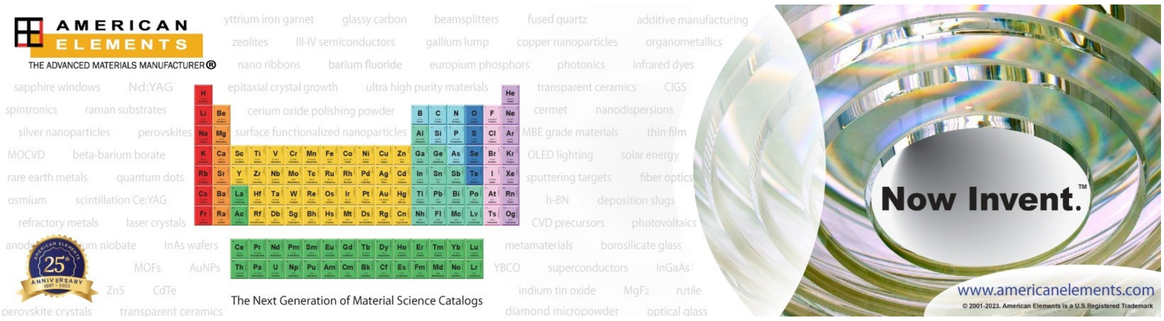

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The power conversion efficiency of organic solar cells has increased to values approaching 20% in recent years, largely driven by the development of new acceptor molecules. This special issue provides an overview of the recent advances in the field of organic photovoltaics with a focus on such non-fullerene acceptor materials.

A current prominent research topic in the field is the investigation of the electro-optical properties of these non-fullerene acceptors (NFAs) and their interactions with donor counterparts. Hasenburg *et al.* address charge transport in the NFA IT-4F using different techniques, such as space-charge-limited current measurements and molecular simulations.[1] Raab *et al.* investigate the film forming properties of one of the field-leading polymer:NFA blends, PM6:Y6, by *in situ* transmission measurements during the spin-coating process. With this method, they show that using the additive chloronaphthalene (CN) in the spin-coating solution leads to a vertical segregation and helps form an improved film morphology.[2] Pranav *et al.* investigate the non-halogenated sibling to Y6, namely Y5. They demonstrate by time-delayed collection field (TDCF) measurements that the reduced fill factor and photocurrent are limited by a field-dependent free charge carrier generation in such blends.[3] Jungbluth *et al.*[4] present fundamental studies on the role of different intermolecular interactions and their impact on energy levels, supporting or hindering charge separation by investigating ZnPc and its fluorinated derivatives combined with C_{60} in donor–acceptor solar cells. As Zhang *et al.* describe in their review, ternary blends based on NFAs constitute a promising avenue for high-efficiency photovoltaics. Here, the design rules, material selection, fabrication methods, and fundamental working principles are described.[5]

Device fabrication considerations, including processing methods and appropriate selective contact layers, are also critical for the performance and scalability of NFA-based organic solar cells. Most NFAs are too large to be vacuum processed and will degrade in an evaporation process. Habib *et al.* demonstrate initial results on vacuum deposited organic solar cells based on the NFA BTIC-H.[6] In the article by Georgiou *et al.*, the importance of selective contact layers to the organic active layer is demonstrated. By doping a SnO_2 layer with antimony combined with a PEI layer, they demonstrate an improved performance for P3HT:PCBM and also for a NFA solar cell, P3HT:IDTBR.[7] A perspective by Hong *et al.* describes the recent advances in the fabrication of organic solar cells based on low-toxicity or non-toxic solvents. The possibilty of large-scale and large-area production is an important consideration for the fabrication of commercial products. Currently, most devices are still prepared with halogen-containing solvents via spin-coating. While this delivers the best organic solar cell performance to date, eco-friendly methods that can be scaled to high-throughput production will be preferable for commercialization.[8]

AUTHOR DECLARATIONS

Conflict of Interest

The authors have no conflicts to disclose.

Author Contributions

L. Schmidt-Mende: Supervision (equal); Writing – original draft (equal); Writing – review & editing (equal). **S. Kraner**: Writing – review & editing (equal). **M. White**: Writing – review & editing (equal). **K. Vandewal**: Writing – review & editing (equal).

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DATA AVAILABILITY

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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