Fabrication of efficient organic solar cell from eco-friendly nanoparticle dispersions utilizing scalable deposition processes

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Roll-to-roll low-cost manufacturing is an often promoted advantage of organic solar cells. As the efficiencies of the organic solar cells have improved steadily over the last decade, the transfer of lab-processes to an industrial production environment will be the pivotal challenge for the next couple of years. Most importantly, the toxic or halogenated solvents that are commonly used for the application of the absorber layer in the lab have to be replaced by more eco-friendly solvents in order to comply with industrial fabrication requirements.

One way to replace these halogenated solvents and therefore to enable the handling of large amounts of solvents is the use of dispersed photo-active organic materials in alcohol or water. Using a precipitation method we fabricated stable nanoparticles in alcoholic dispersions out of P3HT:IC[60]BA with average particle diameters of around 125nm. Integrating the nanoparticles into small-scale inverted solar cells yielded power conversion efficiencies (PCEs) of up to 4.7%, matching the average results obtained when using halogenated solvents for the deposition of the photo-active layer [1].

Upon transferring the deposition process a doctor blading, we yielded PCEs of up to 3.7% (active cell area 0.1cm²) and 3.5% (active area 1.1cm²), respectively. By ink-jet printing we fabricated 2.0% efficient solar cells, altogether successfully demonstrating the readiness of the organic nanoparticle deposition process for upscaling and industrial use.

References

1. S. Gärtner et al., Adv. Mater., 2014, 26, 6653–6657