Eco-friendly spray coating of organic solar cells through water-based nanoparticles ink (Presentation Recording)

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ABSTRACT

Ultrasonic spray coating is currently proven to be a reliable, flexible and cost efficient fabrication method for printed electronics [1-2]. Ultrasonic nozzles are by design especially well-suited to deposit nano-suspension dispersions. Due to the ultrasonic vibration of the nozzle, droplets having a median diameter of 20 μm are created in a homogeneous droplet cloud and directed towards the substrate. When one prepares an ink having the right wetting properties, thin and homogeneous layers, fully covering the surface, can be achieved. Together with conjugated polymer nanoparticles (NPs), emerging as a new class of nanomaterials, [3] it opens possibilities towards eco-friendly roll-to-roll processing of state-of-the-art organic bulk heterojunction solar cells.
A ultrasonic spray coater was used to print the conjugated polymer NP layers under different conditions. A first optimization of the spray coater settings (flow rate, spray speed and temperature) and the ink formulation (water and co-solvent mixture and NP content) was performed for polystyrene particles dissolved in a water-ethanol mixture. As a next step, the low bandgap donor polymer poly[[9-(1-octylnonyl)-9H-carbazole-2,7-diyl]-2,5-thiophenediyl-2,1,3-benzothiadiazole-4,7-diyl-2,5-thiophene-diyl] (PCDTBT) [4] and the fullerene acceptor phenyl-C71-butyric acid methyl ester (PCBM[70]) were combined in a water-based blend NP dispersion which was prepared using the mini-emulsion technique. [5,6] Optical Microscopy, profilometry and Scanning Electron Microscopy (SEM) are performed to study the roughness, surface structure, thickness and coverage of the spray coated layers. Finally the printed NP layers are integrated in organic bulk heterojunction solar cells and compared to spin coated reference devices.
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