We report the implementation and testing of an airbrush coating system for the fabrication of a variety of organic electronic and optoelectronic devices using a commercially available airbrush unit. Our setup was implemented inside a glove box in order to allow the entire fabrication process of the test devices to be performed under nitrogen atmosphere. Several devices such as organic photodetectors, organic light-emitting diodes and organic thin-film transistors were fabricated using commercially available polymers (such as MEH-PPV, P3HT and PCBM). IV-characteristics, as well as film morphology and roughness of spray-coated devices were compared to those of spin-coated devices with similar architecture. Although films deposited by spray coating showed a considerably higher surface roughness, the corresponding devices are capable of achieving performances comparable to those of spin-coated devices.

Spray-coating deposition for large area organic thin-film devices

Spray-coating, organic photovoltaics, organic light emitting diodes, organic photodetectors, organic thin-film transistors
electronic and optoelectronic devices using a commercially available airbrush unit. Our setup was implemented inside a glove box in order to allow the entire fabrication process of the test devices to be performed under nitrogen atmosphere. Several devices such as organic photodetectors, organic light-emitting diodes and organic thin-film transistors were fabricated using commercially available polymers (such as MEH-PPV, P3HT and PCBM). IV-characteristics, as well as film morphology and roughness of spray coated devices were compared to those of spin coated devices with similar architecture. Although films deposited by spray coating showed a considerably higher surface roughness, the corresponding devices are capable of achieving performances comparable to those of spin coated devices. Keywords: spray-coating, organic photovoltaics, organic light emitting diodes, organic photodetectors, organic thin-film transistors. 1 INTRODUCTION Organic electronic devices based on solution-processable polymers are among the most promising applications of organic semiconductors. Low-cost fabrication by means of simple coating and printing techniques is surely one of their greatest advantages. Although several possible deposition techniques are mentioned in literature [1, 2], spin-coating seems to be the method of choice in many research activities presented so far. Despite the simplicity and effectiveness of this technique in producing high quality thin films, it lacks several aspects necessary for large-scale production. One very promising, yet little examined, alternative deposition technique is spray-coating, which would offer much higher suitability and flexibility with respect to large-area industrial-scale application processes [3, 4]. Other advantages of spray-coating as an alternative deposition technique for organic thin-film devices are an easier thickness control over wider ranges, the capability of deposition on non-flat surfaces and lower material losses during deposition, which are of great value for industrial-scale and lab-scale applications likewise. On the other hand, some of the significant disadvantages of this technique are the lower overall layer homogeneity and the extremely high surface roughness when compared to spin-coated layers. Nevertheless, it can be shown, that these issues do not have a significant effect on device performance. Previously, a special spray deposition method called evaporative spray deposition was specially designed in order to obtain smooth polymer layers [5]. This method however involved a vacuum process, which makes it less practical for the implementation in large area deposition systems. In this article we demonstrate the suitability of spray-coating for different classes of organic thin-film devices while comparing them with spin-coated devices of similar architecture. 2 EXPERIMENTAL DETAILS For the deposition of the organic layers by spray-coating, a commercially available airbrush unit (Gabbert Triplex) was used. All ink-containing parts of the airbrush are resistant to organic solvents, such as toluene, and are therefore suitable for the desired application. Our test setup was implemented inside a glove box in order to ensure well controlled environmental conditions throughout the entire fabrication process. Figure 1 shows a schematic drawing of the airbrush coating system, indicating the atomizing gas and material inlets as well as the vertical arrangement of airbrush unit and substrate. Figure 1: Illustration of the implemented airbrush coating system. All experiments were carried out inside a glove box under nitrogen atmosphere. The most important process parameters were found to be atomizing gas (N₂) pressure, nozzle-to-sample distance and spray time. Atomizing gas pressure directly affects the beam profile and the mean drop size. In all our experiments NSTI-Nanotech 2009, www.nsti.org, ISBN 978-1-4398-1783-4 Vol. 2, 2009