Fabrication and characterization of flexible OTFTs via printing methods

Abstract

The present diploma thesis deals with the fabrication via printing techniques and characterization of flexible Organic Thin Film Transistors (OTFTs). The organic materials used for this study were ITO as a gate electrode (PET/ITO substrate), PMMA and PVP (for the dielectric layer) and TIPS-Pentacene (for the semiconductor layer). Firstly, a PMMA layer was fabricated using slot die coating as the printing technique. The optimized printing parameters came across a use of solvents with different boiling points, with O-xylene giving the lowest RMS Roughness of the PMMA film during slot die printing. Because of the dissolving of PMMA from the TIPS-Pentacene solvent (anisole), PVP was used as an alternative organic dielectric material that was also fabricated via slot die printing. After the thin film fabrication, the optimized parameters for the crosslinking procedure were set to 150 ℃ for 30 min after vacuum treatment. The techniques used for the following (semiconductor) layer (TIPS-Pentacene) were slot die coating and spray coating. In slot die coating, 3 printing temperatures were used: 80, 60 and 40 ℃. The optimized temperature was found to be in 40 ℃, because of the slower evaporation rate of the solvent (anisole). In the case of spray coating, large crystal domains were observed, because of the absence of high temperature during the film formation, that leaded in a slow evaporation rate of the solvent. The maximum mobility values of the slot-die coated OTFTs were μ_{max}=2.1× 10^{-3} $cm^2V^{-1}s^{-1}$ and for the spray coated OTFTs the maximum mobility value was μ_{max}=3.7× 10^{-3} $cm^2V^{-1}s^{-1}$. The difference in mobility values can be explained via the different crystallization procedure that takes place in the 2 printing techniques. Finally, the use of a novel substrate –IMI- with lower sheet resistance than ITO was used. The fabricated spray coated TIPS-Pentacene OTFTs with IMI as a gate electrode presented higher mobility values compared to those of ITO, reaching μ_{max}=**19**× $\mathbf{10^{-2}}$ $cm^2V^{-1}s^{-1}$.