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Fluoropolymer Interlayer for Polymer LEDs

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Abstract – The insertion of a thin layer of polytetrafluoroethylene, PTFE, at the interface between PEDOT:PSS and poly(9,9-dioctylfluorene), PFO, in polymer LEDs, leads to improved control of charge balance and device longevity.

The effective work function of PEDOT:PSS/PTFE is increased (~100 meV) when compared to PEDOT:PSS alone and the LEDs characteristics display a significant increase of the external quantum efficiency. The results agree with a scenario in which the PTFE interlayer improves the charge balance and enhances the radiative emission efficiency. Furthermore, PTFE interlayer prevents electrochemical processes occurring at the PEDOT:PSS/PFO interface and this results in an extended longevity of the LEDs.

Ogranic LEDs' performance strongly depends on the charge injection and confinement in the emitting layer since these control the brightness of the devices, the charge balance and, ultimately, their electroluminescence efficiency. In this context poly(ethylene dioxythiophene):poly(styrene sulphonic acid), PEDOT:PSS, has attracted enormous interest as anode, however, PEDOT:PSS has serious drawbacks as, for example, the quenching of the radiative emission efficiency, the intrinsic instability of the blend, its acidic character.

The insertion of a thin layer of polytetrafluoroethylene, PTFE, at the interface between PEDOT:PSS and poly(9,9-dioctylfluorene), PFO, leads to improved control of charge balance and device longevity.

AFM has been used to characterize the morphology of the PEDOT:PSS/PTFE surface. We find that the effective work function, measured by Kelvin-Probe method, of PEDOT:PSS/PTFE is increased of up to ~100 meV when compared to PEDOT:PSS alone. Such a shift in the work function is likely to be ascribed to the presence of superficial dipole on the PTFE layer.

The study of the LEDs characteristics displays an increase of the external quantum efficiency, EQE, of the devices, up to a factor of two at current density of 10mA/cm^2 and the same luminance levels of the control devices for these driving conditions (Figure 1). We analyze the effect of the reduced photoluminescence efficiency quenching as a consequence of the shift of the recombination zone after the insertion of the insulating layer between the anode (PEDOT:PSS) and the emissive layer (PFO). The results agree with a scenario in which the insertion of the PTFE interlayer leads to either an improved charge balance, as a result of a better confinement of the minority carriers (electrons), and enhanced radiative emission efficiency.

The longevity of the devices shows a remarkable increase when PTFE is incorporated (~4 times for the most efficient devices) (Figure 2). Such improvement is likely to be due to the reduced electrochemical interaction between the electroluminescent polymer and PEDOT:PSS as a consequence of the chemical inertness of PTFE.

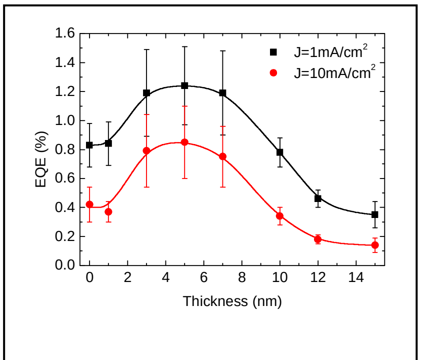

Figure 1: External Quantum Efficiency of ITO/PEDOT:PSS/PTFE/PFO/Ca/Al devices as a function of the PTFE layer.

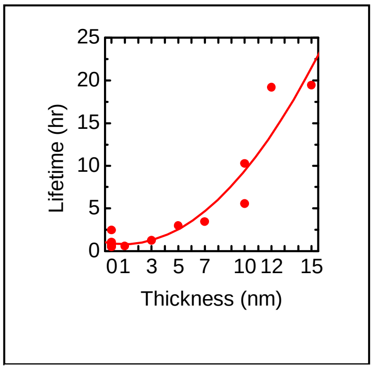

Figure 2: Longevity of ITO/PEDOT:PSS/PTFE/PFO/Ca/Al devices as a function of the PTFE layer.