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Tesis: **"FACTORS THAT AFFECT THE LIFETIME OF PTB7:PC71BM- BASED SOLAR CELLS USING FIELD'S METAL AS TOP ELECTRODE"**

Resumen:

Nowadays, there is a global need to generate new renewable energy sources with a minimal impact on the environment. Among the different technologies being investigated, organic solar cells (OSCs) represent an important option to generate electricity through the photovoltaic effect. OSCs based on organic polymers and low molecular weight molecules, have advantages as low cost materials, easy processing and a great versatility in their design and synthesis. In order to make this technology to become mature and useful in different applications, it is important to achieve OSCs with high conversion efficiency (from light energy to electrical energy) and long lifetime. In spite of its importance, the latter aspect has not been fully studied in the literature. Therefore, to bring OSCs technology from research laboratories to real applications, it is necessary to know the physical mechanisms and processes of degradation that take place in OSCs in order to improve their stability. In this thesis the photovoltaic (PV) performance and stability of OSCs based on the well-known system PTB7:PC71BM and the use of an alternative metal cathod (deposited at low temperature under vacuum free conditions) are studied. In a first part of this thesis, the influence of an electron extraction layer (EEL) and the use of a novel top electrode called Field's metal (FM) deposited by drop casting at regular atmosphere on the PV performance are investigated. Charge extraction and losses involved with the use of FM and PFN as EEL were analyzed using equivalent circuit models for the architecture: ITO/PEDOT:PSS/PTB7:PC71BM/PFN/FM. Power conversion efficiencies (PCEs) higher than 6% were reached with this architecture. Additional electrical characterization, through impedance spectroscopy, was also carried out. The obtained PV parameters are similar to those exhibited by devices comprising standard top electrodes, i.e., Al, deposited through a high-vacuum evaporation process. In the second part of this thesis, and once the fabrication processes was optimized, we proceeded to analyze the scaling effect of the active area using the aforementioned architecture. The cells were scaled by a factor of 25 from 0.09 cm2 to 2.25 cm2, and FM was deposited by doctor blade technique at regular atmosphere. Small active area (0.09 cm2) devices resulted in PCE of 7.4 +- 0.8 %. However, PCE decreased 60% for scaled OPVs (2.25 cm2). After analyzing the initial performance, the attention was focused on the factors that determine the degradation of these devices. Studies of stability as a function of the active area were performed in accordance with the ISOS-L1 (laboratory simulation of constant lighting) and ISOS-D1 (shelf storage) protocols for devices tested in air and without encapsulation. The time to reach 50% of the initial PCE (T50) is about 14 h and 2000 h under ISOS-L1 and ISOS-D1 protocols, respectively, with a tendency of stability improvement for scaled devices. According to our results, the use of FM as top electrode and doctor blade technique for its deposition, could possibly produce an encapsulation effect or a delay in the degradation process. Nevertheless, to make a fair conclusion on this aspect, more experiments have to be carry out. A whole PV analysis through the single diode model, impedance spectroscopy, and light beam induced voltage (LBIV) measurements is presented.