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Thin Film Metal Oxides as Electron Transport Layer for Efficient Polymer Solar Cells

Polymer solar cell (PSCs) have attracted great interest in the field of renewable energy due to their recent increase in power conversion efficiency and low manufacturing costs. [1, 2] In conventional PSCs, calcium and PEDOT:PSS films are commonly used as metal cathode and anode, respectively.[3] Nevertheless, these devices exhibit poor long-time stability and operational lifetimes under environment conditions, and thus require strict encapsulation strategies to reduce degradation under oxygen and moisture.[4] To solve these problems, PSCs with an inverted structure (iPSCs) have been developed. In iPSCs, PEDOT:PSS is replaced by MoO_3 or V_2O_5, while TiOx and ZnO films are used as electron transport layer (ETL) because of their high air-stability, non-toxicity, and high transparency.[5, 6] Our research is focused on TiOx and ZnO nanometric films used as ETL in iPSCs. Several devices were fabricated based on PTB7:PC_{70}BM and PTB7-Th:PC_{70}BM as active layer. The iPSCs based PTB7:PC_{70}BM were fabricated with TiOx as ETL, while devices based PTB7-Th:PC_{70}BM were fabricated with ZnO as ETL. All iPSCs were fabricated using a V_2O_5/Ag bilayer cathode as depicted in Figure 1 (insert). Figure 1 shows the *J-V* characteristics of the best-performing devices. To shed light on the morphological characteristics of the active layers, we recorded AFM micrographs of TiOx and ZnO films as shown in Figure 2. The topography of the TiOx and ZnO films show rather distinct features. The ZnO film exhibits a high surface roughness in comparison to TiOx film that shows a rather flat topography. We found that iPSCs based on PTB7-Th:PC_{70}BM exhibit the best performing using thin films of ZnO of about 30 nm, while the best performing of devices based on PTB7:PC_{70}BM was obtained using 15 nm of TiOx.

References

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Figures

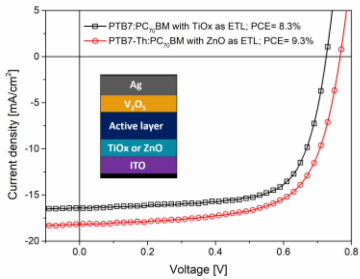

Figure 1: J-V characteristics of best-performing devices. Device structure employed in this study (insert).

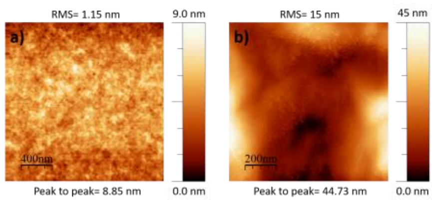

Figure 2: Topography images of a) TiOx film and b) ZnO film. Scale bar: a) 400 nm and b) 200 nm.

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