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Outline

Chapter 1 is general introduction to review the background of cathode buffer layer issues in organic electronic devices. In this chapter, the motivations and objectives of this thesis are illustrated.

In Chapter 2, electrical and optical properties of Zn-Si-O are introduced. Voltage-current characteristics of Zn-Si-O/electrode interface are investigated. Ohmic contact is formed for Zn-Si-O/Al and Zn-Si-O/ITO and an unexpected small Schottky barrier is found for Zn-Si-O/Au interface. Contact resistances are also measured and the results show that Zn-Si-O/electrode is suitable for application in both OLEDs and OSCs.

In Chapter 3, application of Zn-Si-O to both single junction and tandem inverted OLEDs are studied. For single junction inverted OLED, Zn-Si-O works as an effective electron transport/injection layer and the performance is significantly improved comparing with conventional oxide materials (ZnO and ITO). For inverted tandem OLED, Zn-Si-O work as both electron injection layer and charge generation layer. 16

Combining with high work function oxide, MoO_3, low voltage loss charge generation layer is achieved. Although the work function difference between MoO_3 and ZSO is large, a quasi-Ohmic contact is formed due to the generation of gap state in MoO_3 when Zn-Si-O was sputtered on MoO_3.

In Chapter 4, application of Zn-Si-O to bulk heterojunction polymer solar cells (PSCs) are studied. Results show that Zn-Si-O can be an effective electron extraction layer (EEL) for PSCs with room temperature deposition process. Benefiting from the lower work function comparing with ZnO, the power conversion efficiency of PSCs with Zn-Si-O EEL is increased.

In Chapter 5, influence of post plasma treatment to Zn-Si-O/organic semiconductor interfacial energy alignment is studied. Research results show that by introducing different gas during plasma treatment, the work function of Zn-Si-O thin films can be recovered or increased and the interfacial energy alignment is significantly different. These researches provide a surface cleaning method to air exposed Zn-Si-O thin films which is important for practical produce and extend the application field of Zn-Si-O to organic-inorganic hybrid solar cells.

In Chapter 6, summaries of this thesis are given.