Horizontal Orientation of Planar Type-Hole Transport Molecules and their Application for Organic Light-Emitting Diodes Aimed for Low Driving Voltage

Oganic light-emitting diodes (OLEDs) continue to be of great interest because they realize not only high energy conversion efficiency but also mechanically flexible and lightweight display and lighting applications. [1)] Recently, large optical anisotropies were identified in films of hole and electron transport materials such as TPT1 and Bpy-OXD having rather long and planar backbone structures.[2)] The method of wide-range variable angle spectroscopic ellipsometry (VASE) clarified that the molecules having a long rod-like structure show horizontal orientation on any underlying layers.[3)] Also, high performance optical and electrical characteristics were demonstrated, based on the enhancement of π-π interaction between adjacent molecules In this study, we further developed novel molecular structures of B-DDP, T-DDP, BT-DDP aimed for the enhancement of horizontal orientation by introduction of our idea of two-dimensional planar structures having rather intense π-π interaction, leading to further low driving voltage in OLEDs. *S* is orientation order parameter (*S*=−0.5: completely parallel, *S*=0: randomly oriented, *S*=1: completely perpendicular to the surface). In the DDP derivatives, the order of *S* is BT-DDP (−0.23) < T-DDP (−0.18) < B-DDP (−0.11) < *α*-NPD (−0.01). In the OLED characteristics, compared with *α*-NPD, the use of DDP derivatives resulted in lower driving voltage. In particular, BT-DDP showed the lowest driving voltage which is consistent with the VASE result. We clarified that the ITO/ BT-DDP interface provides small energy for hole injection probably due to the planar orientation of BT-DDP on an ITO surface.

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