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

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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. Recently, horizontally oriented amorphous thin films have been used in OLEDs, making use of their high-performance electrical characteristics. [1)] 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.

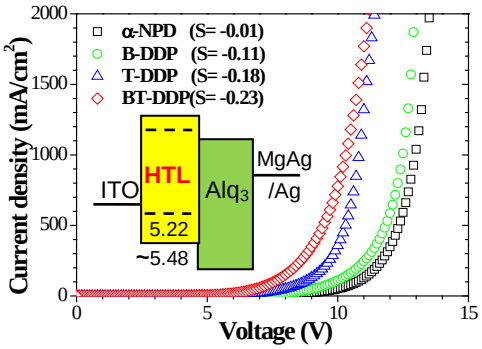

Fig. 1 OLED characteristics in ITO/X-DDP (50 nm) /Alq (50nm) /Mg:Ag (100 nm)/Ag (10 nm). Symbols indicate material and order parameter of X-DDP layers.

[1] D. Yokoyama, A. Sakaguchi, M. Suzuki and C. Adachi, *Appl. Phys. Lett*. **95**, 243303 (2009)