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Opto-electrical Properties of Ag-doped Bathocuproine and Energy Level Alignment for Organic Solar Cells

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Organic solar cells (OSCs) have been attracted significant attentions due to the advantages of low cost, fexibility and lightweight. However, they are still far away from the commercialization, and one of the significant reasons for that is the degradation of the device performance. The inverted structure is a feasible approach to improve the liftime of OSCs. Bathocuproine (BCP) is an electron transport material, which is always used as a buffer layer in the traditional structure OSCs to improve the power conversion efficiency. In the present work, we investigated the optical and electrical properties of Ag-doped BCP, and energy level alignment with C_{60}. It was found that Ag-doped BCP is a potential buffer layer for the inverted structure OSCs.

The optical transmittance was measured using a UV/Vis spectrometer (JUSCO Inc., V-670). The photoluminescence (PL) were carried out by using a 532 laser as excitation source. The power of the laser is 10 mW. Raman spectra were acquired by a CCD spectrophotometer. The electronic properties of inerfaces at different doping concentration were carried out at BL-3B of the Photon Factory at KEK.

The results show that the transmittance of Ag-doped BCP layer is strongly dependent on the doping concentration. In case that the BCP layer was slightly doped by Ag, the transmittance is nearly the same as that of the non-doped layer. As the doping concentration increased, the transmittance obviously decreased. At the low doping concentration of Ag in BCP, the PL intensity of C_{60} deposited on Ag-doped BCP was almost the same as that of on non-doped BCP, as shown in Fig. 1, whearas the quenching occurs when the doping concentration is high. In our previous study [1], we found that the conductivity of BCP can be improved by Ag doping. In this work, the UPS results show that new gap states exists at the interface of C_{60}/Ag doped BCP, whereas no gap states exist in the undoped case. We suppose that the gap states are formed by the interaction between Ag and BCP [2], and these states improved the conductivity of doped layer. They can also provide new channels for the electrons transport, which are favorable to the electrons transport in the devecs.

In conclusion, the Ag-doped BCP layer with light doping shows high transparency, strong photoluminescence, good conductivity and exsitance of gap states at the interface. That means the Ag-doped BCP layer with low doping concentration has great potential to serve as a buffer layer in the inverted structure OSCs.

References:

[1] T. Sakurai, S. Toyoshima, H. Kitazume, S. Masuda, H. Kato, K. Akimoto, J. Appl. Phys., 107 (2010) 043707.

[2] S. Wang, T. Sakurai, R. Kuroda, K. Akimoto, Appl. Phys. Lett., 100 (2012) 243301.

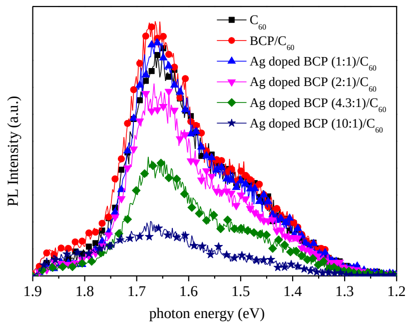

Fig.1 PL spectra of C_{60} deposited on Ag doped BCP layer