
Appendix A. The Effect of TPD Concentration on Device Efficiency

In this appendix we study the effect of TPD concentrations in the single and bi-layer devices. TPD was earlier shown to function as a hole trap at low concentration and a hole-transporting agent at high loading when doped into PVK¹. We will show that, in both cases, adding more TPD for low concentration in the blend of $PVK : PBD : Ir(mppy)_3 = 61 : 24 : 6$ would reduce our device efficiencies, although in some cases luminance would increase.

For the single-layer devices we mean the structure of PEDOT/LEP/LiF/Ca/Al. The reasons for us to tune the TPD concentration in the single-layer structure is that we understand that for the case of CsF/Al being the cathode, the single-layer devices are very balanced for holes and electrons. However, at the beginning of experiments we did not have Cesium fluoride. Therefore we would like to reduce the hole injection. We reduce the TPD concentration from the original 9 per cent to zero per cent to see the response of our devices. Figure A.1 is the double-Y diagram of the luminous efficiency and the current density versus various TPD concentrations.

We may observe that, when the TPD range is from 0 per cent to 4 per cent, although the current densities of the devices almost remain the same, luminous efficiencies dramatically drop from 14 cd/A to 6 cd/A. However, if we add more TPD to make the concentration from 4 per cent to 9 per cent, we observe that the luminous efficiency climbs back to 14 cd/A. It seems that there is a minimum yield for the TPD concentration between 0 per cent to 4 per cent. On the contrary, it seems very clearly that the current density steadily increases with increasing TPD concentrations.

Next we discuss various TPD concentrations in the double-layer devices with the structure of PEDOT/TFB/LEP/CsF/Al. Figure A.2 shows that the device efficiency (both for PCE and Y) decreases with increasing TPD concentration when it goes from 0 per cent to 9 per cent. Luminous efficiencies of devices with TPD concentrations of 0 per cent, 3 per cent, and 9 per cent are about 27 cd/A, 24 cd/A, and 18 cd/A, respectively. However, the

¹D.M. Pai, J.F. Yanus, and M. Stolka, J. Phys. Chem. 88, 4714 (1984).

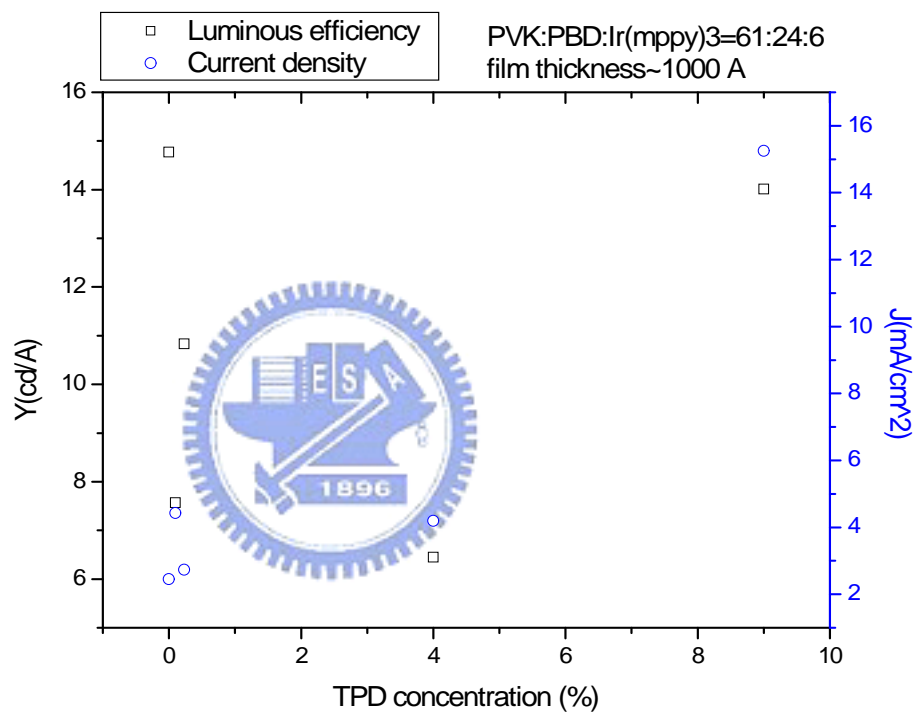


Figure A.1: The double-Y diagram representing the relationships between the yield and TPD concentration or between the current density and TPD concentration.

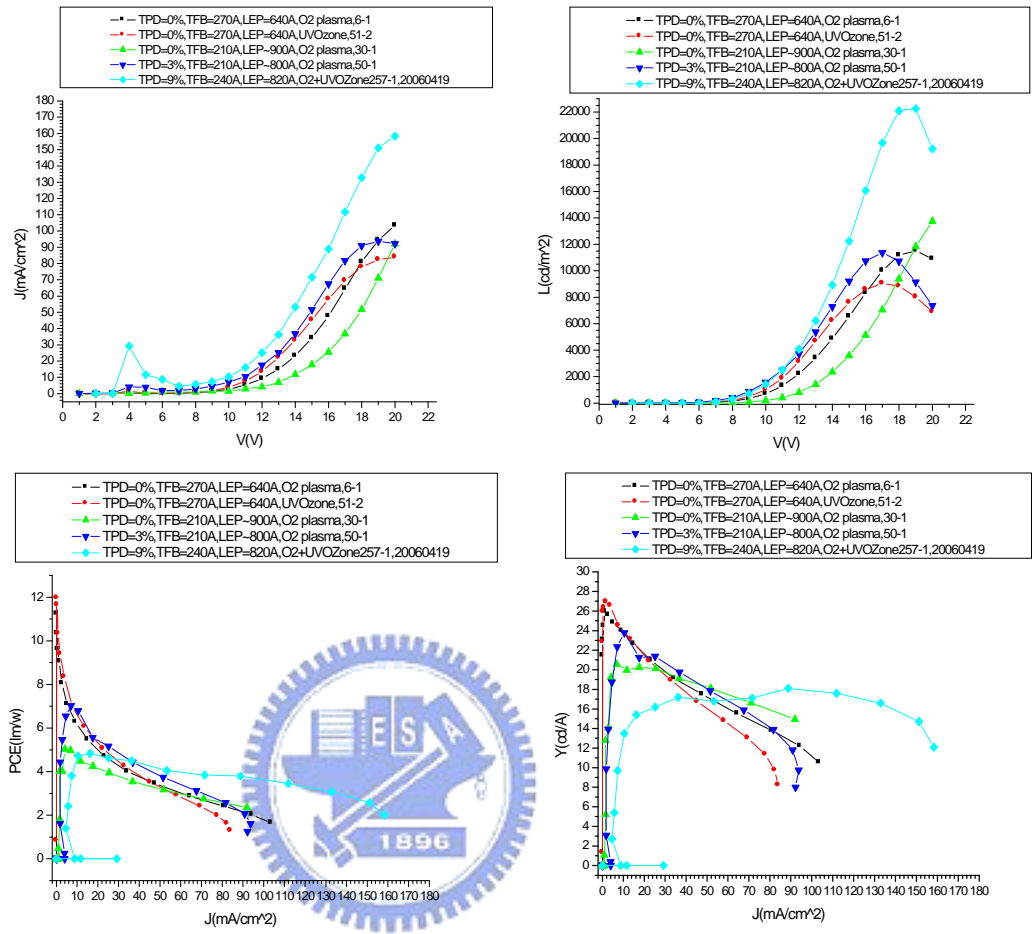


Figure A.2: Effect of TPD concentration on the double-layer devices with CsF/Al cathode.

highest luminance is achieved by the device with TPD concentration of 9 per cent.