研究快报

高稳定性的红色有机薄膜电致发光器件

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关 键 词：高稳定性；红色发光；有机薄膜电致发光
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有机薄膜电致发光作为新型的平板显示器件受到人们广泛的关注。有机发光器件研究的一个目标是发展全色显示。目前绿色和蓝色器件都实现了高亮度和长寿命。有关红色有机发光器件也有一些报道。如C.W.Tang等报道的DCM红光器件[1]，J.Kido[2]利用稀土有机物作为红色发射体，P.E.Burrous报道的TPP掺杂[3]，Y.Hamada报道的ZnTPP掺杂[4]，M.A.Baldo利用PtOEP[5]都得到红光。最近Y.Hamada报道利用rubrene作为辅助掺杂得到的红光器件色度不随电压的变化而变化[6]。然而对红色器件的稳定性很少有报道。本文作者报道采用DCJT作红光染料，得到高稳定性的红色器件。最高亮度达4 867cd/m^2(17V)，最大效率0.83lm/W，色度x=0.63，y=0.37。在直流电压驱动下，初始亮度150cd/m^2，半亮度寿命2 500小时，老化过程中，器件电压的增长率0.6mV/h。按彩色显示技术的要求，红色:绿色:蓝色为30:59:11(欧洲广播协会标准)[7]，即色红只要求为绿色亮度的一半。初始亮度可按50cd/m^{2}计，则半亮度寿命可折合为7 500小时。

所用有机材料的分子结构示于图1。将ITO玻璃衬底经清洗及plasma处理后放入1.33×10^{-4}Pa的真空室内，相继蒸发缓冲层CuPc(20nm)，空穴传输层NPB(60nm)电子传输层及发光层Alq3:DCJT(60nm)，然后制作金属电极Mg:Ag(1:9)，其中发光层及金属电极均采用双源蒸发的方法，最后器件密封测量。

图2给出了器件的结构和电致发光光谱，光谱为峰值在620nm的宽带。色度为x=0.63，y=0.37。光谱随电压没有明显变化。

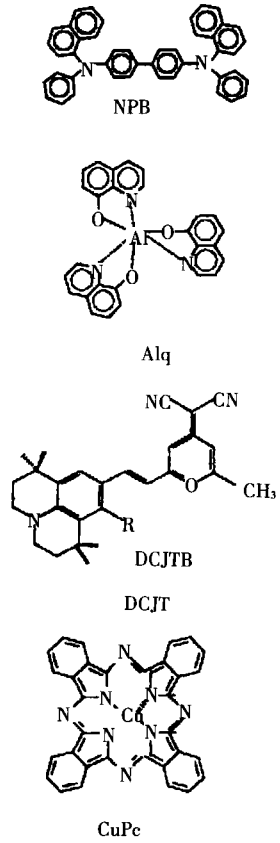

图1 所用有机材料的分子结构

Fig.1 Molecular structures of organic materials used.

图3所示为器件的亮度-电压及电流-电压曲线，由图可见，器件的最高亮度为4 867cd/m^2(17V)，最高效率为0.83lm/W(5V)。

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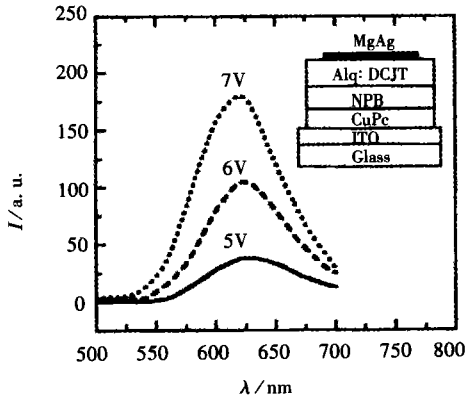

图 2　器件的结构(插图)和电致发光光谱

Fig.2　The structure of device(inset) and electroluminescent spectra.

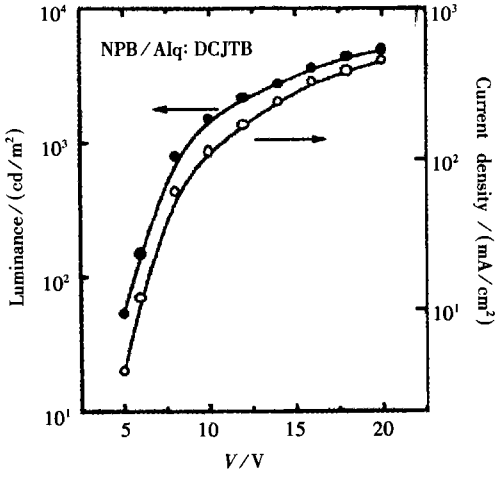

图 3　亮度-电压及电流-电压曲线

Fig.3　Dependences of luminance on applied voltage and current density on voltage.

器件的老化曲线示于图 4，老化是在 12mA/cm^2 的直流电流下连续进行的。由图可见，初始亮度 150cd/m^2 下降至半亮度时间是 2 500 小时，但器件仍在工作，考核还在进行中。老化过程中

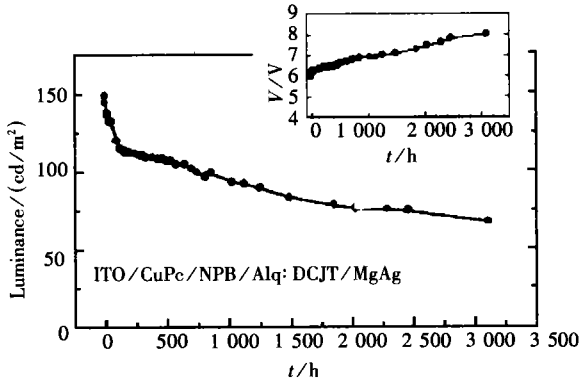

图 4　在 12mA/cm^2 的直流电流连续作用下发光的衰减曲线及驱动电压的变化(插图)

Fig.4　Luminance degradation under 12mA/m^2 continuous operation and the change of driving voltage with time(inset).

驱动电压的变化示于插图中，电压的增加较小，在 2 500 小时内电压上升 1.5V，电压上升的速率为 0.6mV/h。这表明势垒是稳定的。按彩色显示技术的要求，红色：绿色：蓝色为 30：59：11(欧洲广播协会标准)，即红色只要求为绿色亮度的一半。初始亮度可按 50cd/m^2 计，则半亮度寿命可估计为 7 500 小时。

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High Stable Red Organic Emitting Diode

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Abstract

A stable red organic light-emitting device has been realized by doping a red dye tetra-methyljuloidine (DCJT)in electron transporting layer(ETL). The structure of the device was ITO/CuPc/NPB/Alq:DCJT/MgAg, where copper phthalocyanine(CuPc) was used as a buffer layer, N, N'-bis-(1-napthyl)-N, N'-diphenyl-1, 1'-biphenyl-4, 4'-diamine(NPB) as the hole transporting layer, tris(8-quinolinolato) aluminum complex(Alq) as ETL, in which DCJT was doped, indium tin oxide(ITO) and MgAg were as the anode and cathode, respectively. The red emission with peak at 620nm and CIE coordinates $x=0.63$, $y=0.37$, maximum luminance 4 687cd/m^2, maximum luminous efficency 0.83lm/W were obtained. The device showed a high stability under 12mA/cm^2 current density continuous operation, the half decay time reached 2 500 hours at the initial luminance 150cd/m^2 and the change of driving voltage was 0.6mV/hour in the degradation process. If 50cd/m^2 is taken as the initial luminance of red device, the half decay time is considered to be 7 500 hours. (According to European Broadcasting Union(EBU) standard, for color display the ratios for red, green, blue luminance should be 30%, 59% and 11%, respectively, since 100cd/m^2 is often used as initial luminance of green emission in degradation test, 50cd/m^2 should be adapted as the initial luminance for red emission.)

Key words: high stability; red light emitting; organic thin film electroluminescence

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