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器件制备及器件物理

全湿法制备聚合物白光器件

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摘要： 使用全溶液法制备聚合物白光器件，通过引入修饰层并改变各层薄膜厚度来优化器件性能。针对ITO 阴极功函数较高的问题，引入功函数较低的蓝光聚芴衍生物：聚[9,9-二辛基芴-9,9-双（N,N-二甲基胺丙基）芴]（PFN），有效地降低了阴极的复合功函数。同时PFN也是电子注入材料和发光材料。为降低器件的启动电压，引入Cs_2CO_3作为修饰层，同时也提高了电子传输能力。使用MEH-PPV作为橙红光材料。使用二次溶剂掺杂获得的高导PEDOT：PSS聚合物并通过滴膜的方法制备阳极取代了传统的金属电极真空镀膜法，从而使器件制备简单、快捷。最终得到了湿法制作的聚合物白光器件的光谱范围为400~800 nm，涵盖了整个可见光区域。器件的启亮电压为4 V，亮度为1 500 cd/m^2，电流效率为0.55 cd/A。
关键词： 全湿法 白光电致发光 PFN MEH-PPV

Fabrication of White Polymer Light-emitting Diodes Using All-solution Method

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Abstract: The all-solution method was employed as a vacuum-free technics to fabricate white light-emitting diodes. The performance of the device was optimized by adding a modified layer and optimizing the thickness of each layer. ITO was used as the cathode, and PFN film was added to reduce the work function of the cathode. The polymer PFN was also used as the electron injection material and the blue emitter. The polymer MEH-PPV was used as orange emitting layer. By introducing Cs_2CO_3 as modified layer, the turn-on voltage was reduced and the electron injection ability was improved effectively. The highly conductivity PEDOT:PSS film was employed to replace metal electrode as the anode. The results show that the EL spectra of the device extend from 400 nm to 800 nm, covering the whole visible region, the device starts to glow at 4 V and exhibits a maximum luminance of 1 500 cd/m^2 with a maximum current efficiency of 0.55 cd/A.
Keywords: all-solution method white light-emitting PFN MEH-PPV
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参考文献：

[1] Tang C W, VanSlyke S A. Organic electroluminescent diodes[J]. *Appl. Phys. Lett.,* 1987, 513(12):913-914.

[2] Kido J, Hongawa K, Okuyama K, *et al.* White light-emitting organic electro luminescent devices using the poly(N-vinylcarbazole) emitter layer doped with three fluorescent dyes[J]. *Appl. Phys. Lett.,* 1994, 64 (7):15-816.

[3] Hebner T R, Wu C C, Marcy D, *et al.* Ink-jet printing of doped polymers for organic light emitting devices [J]. *Appl. Phys. Lett.,* 1998, 72(5):519-521.

[4] Reineke S, Lindner F, Schwart Z G, *et al.* White organic light-emitting diodes with fluorescent tube efficiency[J]. *Nature,* 2009, 459:234-237.

[5] Yang Y, Huang J S, Li G, *et al.* Achieving high-efficiency polymer white-light-emitting devices[J]. *Adv. Mater.,* 2006, 18(1):114-117.

[6] Li J, Hua Y L, Niu X, *et al.* Enhancement of the luminescence performance of polymer light-emitting diodes with single layer structure by heat treatment[J]. *Chin. J. Lumin.(发光学报),* 2002, 23(2):171-174 (in Chinese).

[7] Wang Q, Ma D G. Fbrication methods of white organic light-emitting diodes[J]. *Chin. J. Liq. Cryst. Disp.(液晶与显示),* 2009, 24(5):617-629 (in Chinese).

[8] Xu D H, Adachi C. Organic light-emitting diode with liquid emitting layer[J]. *Appl. Phys. Lett.,* 2009, 95

(5):053304-1-3.

[9] Zhang H, Wang L, Rong J L, *et al.* Efficient inverted top-emitting organic light-emitting devices with cesium carbonate modified Al cathode[J]. *Chin. J. Lumin.(发光学报),* 2012, 33(6):611-615 (in Chinese).

[10] Cai Y, Wei H X, Li J, *et al.* Mechanism of Cs_2CO_3 as an n-type dopant in organic electron-transport film[J]. *Appl. Phys. Lett.,* 2011, 98(11):113304-1-3.

[11] Chen M H, Wu C I. The roles of thermally evaporated cesium carbonate to enhance the electron injection in organic light emitting devices[J]. *J. Appl. Phys.,* 2008, 104(11):113713-l-3.

[12] Huang J, Xu Z, Yang Y. Low-work-function surface formed by solution-processed and thermally deposited nanoscale layers of cesium carbonate[J]. *Adv. Funct. Mater.,* 2007, 17(12):1966-1973.

[13] Huang F, Wu H B, Cao Y, *et al.* Polyfluorene polyelectrolytes and their precursors processable from environment-friendly solvents[J]. *Curr. Org. Chem.,* 2007, 11(14):1207-1219.

[14] Wu H B, Cao Y, He Z C, *et al.* Enhanced power-conversion efficiency in polymer solar cells using an inverted device structure[J]. *Nature. Photon.,* 2012, 6(9):591-595.

[15] Shen L Y, Wu X M, Hua Y L, *et al.* Improving the efficiency of blue organic light-emitting diodes by employing Cs-deravitives as the n-dop ant[J]. *Acta. Phys.-Chim.sinica* (物理化学学报), 2012, 6(28):1497-1501 (in Chinese).

[16] Yuan T L, Wang X F, Mu Q, *et al.* White light-emitting with mixed stcture[J]. *Chin. J. Liq. Cryst. Disp.(液晶与显示),* 2008, 23(5):676-679 (in Chinese).