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利用多周期量子阱结构提高有机发光二极管的效率

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摘要： 研究了几种具有不同周期数的量子阱结构和不同势垒层厚度的有机电致发光器件的特性。器件中的量子阱结构是由tris-(8-hydroxyquinoline) aluminum (Alq_3)和2,9-dimethyl-4,7-diphenyl-1,10-phenanthroline(BCP)两种材料制备的。其中Alq_3层作为电子的势阱层,BCP层作为电子的势垒层。实验结果表明,两个周期的阱结构器件的电流效率最高,为3.46 cd/A,大约是传统三层结构器件的1.6倍。器件电流效率的提高是由于当阱结构周期数增加时,阱结构对载流子的限制作用会增强,这使得势阱层(发光层)中激子的形成几率增大,因此器件效率提高。但是当量子阱周期数太大时,电流效率反而会降低。在实验过程中,还研究了不同势垒层厚度对器件特性的影响。实验结果表明,选用适当的阱结构周期数和适当的势垒层厚度,可以提高有机电致发光器件的性能。

关键词： 有机量子阱结构 电致发光 亮度 电流效率

Enhancing Efficiency of Organic Light Emitting Diodes by Using Multi-Period Quantum Well Stucture

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Abstract: Several organic electroluminescent devices with different cycle of quantum well structure and different barrier thickness have been demonstrated. The quantum well structures were composed by tris-(8-hydroxyquinoline) aluminum (Alq_3) and 2,9-dimethyl-4,7-diphenyl-1,10-phenanthroline (BCP). The Alq_3 layer is the potential well of electrons and BCP layer is the potential barrier of electrons. The twice well structure device exhibits the highest current efficiency of 3.46 cd/A, which is about 1.6 times of the conventional three-layers organic light emitting devices. The current efficiency improved owing to carrier confinement and higher exciton formation probability in the well layer (light-emitting layer) when the quantum well period increasing, then the current efficiency would enhanced. But when the quantum well period is too large, the current efficiency will decreased. The devices with different barrier thickness have also been studied in our research, the influence of barrier thickness on current efficiency have been compared. Results illustrated that proper well number and barrier layer thickness can improve the current efficiency of organic light emitting devices.

Keywords: organic quantum well structure electroluminescence brightness current efficiency

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