MASTER'S THESIS

Organic light-emitting diodes

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Abstract

Organic light emitting diodes (OLEDs) are thin film devices fabricated from organic solids. Despite the success in the technology of making bright organic LEDs, many fundamental issues are not understood. In this thesis, the fabrication techniques of OLEDs and their electrical and optical properties were investigated. The OLED system under study is a bilayer organic device (ITO/TPD/Alq_3/Ag). The experimental setup, procedures and charge transport mechanism through the organic materials are discussed in detail. We discovered that at high operating voltages, the current-to-voltage characteristic of the OLED system is bulk-limited by the Alq_3 layer. A space-charge-limited (SCL) current model can be used to describe the charge transport through an OLED.

As the thickness of the Alq_3 layer varies, an optimum external quantum efficiency (~1.48%) for the OLEDs is reached when the Alq_3 layer thickness is about 500-600 Å. This thickness is consistent with optical interference effects between the light-emitter and its mirror image. The electroluminescent (EL) peak has systematic red shift when the Alq_3 layer thickness is less than 1275 Å. When the Alq_3 layer thickness is between 1275 and 1530 Å, two distinct EL peaks appear. These observations can be attributed to the micro-cavity effects inside the device.

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