

Enhanced performance of OLED based on a molecularly doped polymer

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Nowadays, multilayer OLED structures with electron and hole transport materials as well as additional buffer layers are fabricated in order to improve the device efficiency. However, multilayer diodes are difficult to fabricate due to the requirement of depositing several layers on top of each other. As an alternative approach, single layer devices using blends of an emitting polymer with a carrier-transporting material have been investigated. Less fabrication steps are therefore needed because only spin-coating process for the blend solution is required. Furthermore, reducing the number of interfaces in these devices may also reduce losses via trapping states.

The objective of the present work is to obtain a single organic layer showing efficient emission and both electron and hole conduction, without having to go through complex chemical synthesis. To achieve such target, a layer of 2-methoxy-5-(2-ethylhexyloxy)-p-phenylene vinylene, namely MEH-PPV was doped with the electron conductor tris(8-hydroxyquinoline) aluminium Alq₃. In conjugated polymer films, it is generally considered that the charge transport is a disordered hopping process. Charge carrier mobilities in these disordered systems are dominated by the rate of charge transport between neighboring hopping sites. Therefore, by doping the conjugated polymer, it is possible to adjust the mobilities of the charge carriers by controlling the distance between hopping sites. More importantly, we can improve both the carrier injection and carrier transport by carefully selecting the component polymer for blending and by adjusting their fractions in the blend polymer LEDs.

We will show here that using a blend of 20% of the total weight of Alq₃ within MEH-PPV, we obtain lower turn on voltage for light emission and an increase of an order of magnitude for the OLED efficiency. The ratio of Alq₃ into MEH-PPV has also been varied to study its influence on the OLED efficiency. We will give an explanation of the different behaviour of the device at low and high composition of Alq₃ in the blend. Furthermore, using a postannealing at 50°C enables to further obtain up to a three fold increase of the luminance of the blend based-device. Following on such influence of the temperature of the device, we will show a full study of temperature on the device performance and link it to the glass transition temperature of both materials as well as of the blend.