

Abstract

In this work a potential new OLED application is presented: a large-area purple OLED for horticultural application, which combines red and blue light emissions in a unique device.

The main issue of this thesis is to demonstrate the effectiveness of the proposed OLED structure by using theoretical models created during the three years of the Ph.D. studies and applied to commercial materials.

The core of this dissertation is the third chapter, where the reader is brought to the optimization of the final purple OLED structure after several experiments, which confirm either the basic concepts explained in the two previous chapters, either a mathematical model for a fine-tuning of the blue emission layer.

Behind the proposed device architecture and material employed, there is the concept of “hybrid OLEDs with triplet harvesting”, where a proper combined use of fluorescent and phosphorescent emitting materials allows a theoretical internal quantum efficiency of 100%.

The last chapter is focused on the study and the realization of metal grids on the indium-tin-oxide (ITO), which is the most used material as transparent and conductive anode for the OLED devices.

Despite ITO owns good property of transmittance (transparency), because of its limited conductivity, a lateral voltage drop occurs, preventing a homogeneous emission when the dimensions of the devices exceeds few square centimetres.

To overcome this problem, it is presented a new mathematical model which, unlike the most established literature models do, takes into account both the electrical influence of the metal grid and that one of the ITO.

Finally, with a good agreement with the experimental data, the theoretical model is used to predict optical and electrical behaviour of different hexagonal metal grid on ITO.

It worth to underline that all the approaches implemented in this work to achieve a large-area purple OLED, have a general validity. Indeed, the entire know-how in this thesis it has been successfully used, in the last three years, to make several different OLED devices, different for colour emission, size and performances.