Optoelectronics and Semiconductor Group
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Field of study: organic light-emitting devices, semiconductor device physics, OLED device simulation
Key words: OLED, device simulation
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1. The Subject and Aims of Research

Recent research aims at studying the mechanisms of organic light-emitting devices (OLEDs) and developing a simulation tool for OLED. It is believed that OLEDs will become the main stream technology for next-generation flat panel displays due to their low power consumption, high brightness, high contrast, and potentially low-cost high-performance self-emissive display. Therefore, it is necessary to further understand the fundamental device physics and to develop a simulation tool. In the current stage of OLED development, device modeling has become very helpful in that modeling accelerates the process of device optimization.

2. Related Recent Research Topics

1. Electrical and optical characteristics simulation of OLED:

   We present a numerical model for the quantitative simulation of undoped multilayer OLEDs, which includes electrical and optical modeling together. The electrical characteristics calculation is carried out by using the drift-diffusion equations that contain charge carrier drift with field-dependent mobility, charge carrier trapping, the heterojunction interface and the recombination process, while the optical characteristics simulation is based on material absorption and the optical interference effect due to the refractive index discontinuities in the device. The output of the simulation modeling proposed in this article includes the luminance, EL spectrum, CIE coordinates and *I-V* characteristics.

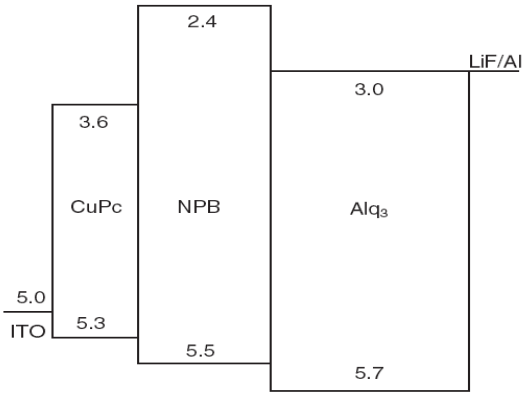

Fig.1、Device structure of multilayer OLED

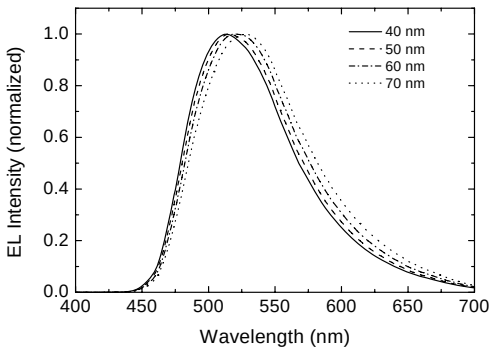

Fig. 2 Simulation results of EL spectrum for device with four different Alq_3 thicknesses

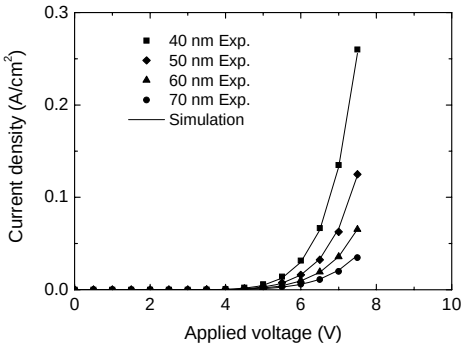

Fig. 3 Simulation results of electric characteristics for device with four different Alq_3 thicknesses.

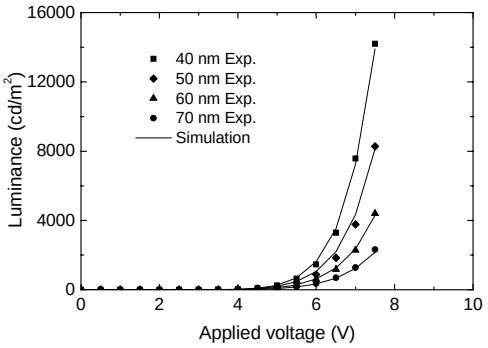

Fig. 4 Simulation results of luminance characteristics for device with four different Alq_3 thicknesses.

2. Electrical simulation of doping OLED:

Doped organic light emitting diode has well-established benefits enhanced quantum efficiency. We include charge carrier trapping and direct carrier recombination phenomena on the fluorescent dopants in the simulation. It provides insight into the current density, charge distribution and direct carriers recombination on the fluorescent dopant.

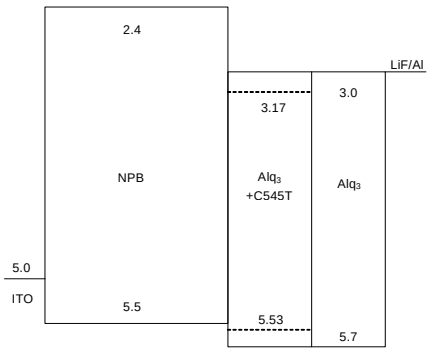

Fig. 5 Schematic energy diagram for the doping device**.**

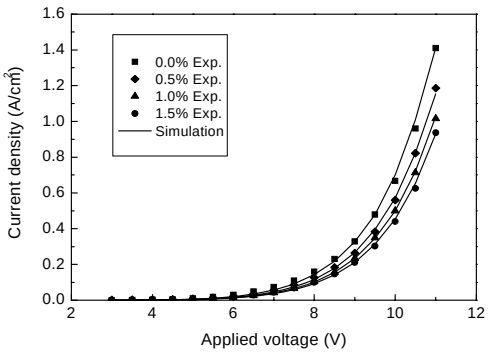

Fig. 6 *J-V* characteristics for devices with four different doping ratios.

3. Selected Publications and Projects

Publications:

1. **C. C. Lee**, Y. D. Jong, P. T. Huang, Y. C. Chen, P. J. Hu and Y. Chang, "Numerical simulation of electrical model for organic light-emitting devices with fluorescent dopant in the emitting layer," *Japanese Journal of Applied Physics*, vol. 43, no. 11, pp. 8147-8152, 2005.
2. **C. C. Lee**, M. Y. Chang, Y. D. Jong, T. W. Huang, C. S. Chu and Y. Chang, "Numerical simulation of electrical and optical characteristics of multilayer organic light-emitting devices," *Japanese Journal of Applied Physics*, vol. 43, no. 11A, pp. 7560-7565, 2004.