

## Luminescent and Morphological Properties of Color Tuning Device Composed of Alq<sub>3</sub> and PDPMA doped by Fluorescent Dye

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Organic EL device with a dye-doped polymeric hole transporting layer, i.e. a device consisting of ITO / dye doped Poly[N-(p-3-diphenylamine)phenylmethacrylamide](PDPMA) / Alq<sub>3</sub>, was fabricated and investigated. Using three different fluorescent dyes (Nile red, DCM, and TPP) at various compositions as guest emitting materials, the relations among the spectral overlap, emission characteristics, the physical, chemical and morphological properties were studied.

**Keywords:** PDPMA; fluorescent dyes; spectral overlap; PL intensity; surface morphology

### INTRODUCTION

Intensive attention has been given to organic electroluminescence phenomenon and a great deal of progress has been made[1]. Recently there is growing interest in host-guest type organic EL device, which has been shown to have important improved characteristics such as emission efficiency[2] and good physical and chemical stability[3].



PDPMA was synthesized in our laboratory and fluorescence dyes (nile red, DCM, and TPP) were purchased from Aldrich. Mixtures of PDPMA and dye were dissolved in monochlorobenzene at 2 wt%, which was spin-coated at 2000 rpm onto ITO coated glass. Alq<sub>3</sub> layer was deposited on this layer under the pressure of  $1 \times 10^{-5}$  Torr by ULVAC VPC-200F evaporator. The UV-visible spectra were measured using UV 570 (JASCO Instrument), and the PL spectra were obtained using Acton 300i Spectrofluorometer. The surface morphology was observed by Atomic Force Microscopy (Auto Probe, PSIA). The chemical structures of the materials used in the study were shown in Figure 1.

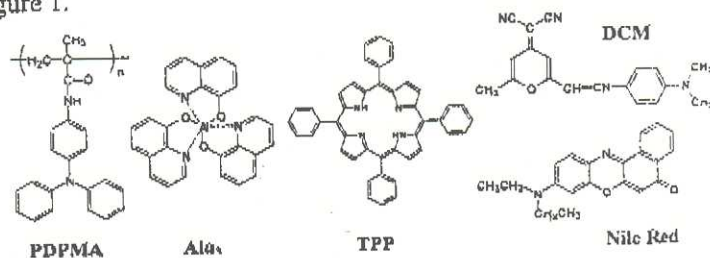


FIGURE 1. Molecular structures of PDPMA, Alq<sub>3</sub> and dye dopants

## RESULTS AND DISCUSSION

Figure 2 shows the EL spectrum of Alq<sub>3</sub> and the absorption spectra of various dye dopants. Spectral overlap between Alq<sub>3</sub> and Nile red and DCM is evident, from which the efficient energy transfer between these molecules is expected. However little overlap between Alq<sub>3</sub> and TPP was observed.

Figure 3 shows the PL spectra of the device where PDPMA was doped



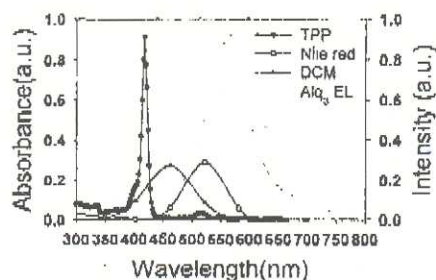


FIGURE 2. Spectral overlap of EL spectra of Alq<sub>3</sub> and absorption spectra of dyes.

by the above three dye molecules at various compositions. The PL intensity increased as the composition of Nile red and DCM was increased initially, and then began to decrease. The concentration at which maximum PL intensity was observed was 0.5 wt% for Nile red and 0.8 wt% for DCM. The PL intensity of TPP is the lowest as expected and the change in the intensity with the concentration was also very small.

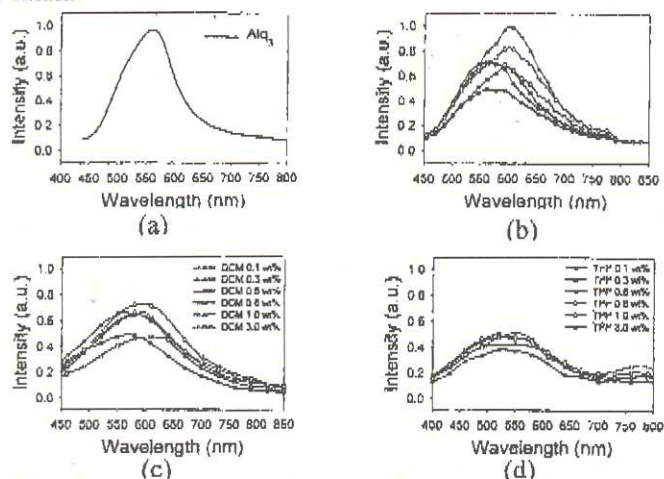


FIGURE 3. PL spectra of the device with undoped and doped PDPMA (a) undoped, (b) Nile red, (c) DCM, (d) TPP

The surface morphologies at three Nile red compositions were presented in Figure 4. It is interesting to note that the surface roughness was reduced near the composition at which the optimal PL intensity was obtained (0.5 wt% Nile red). The qualitatively similar results were also observed for DCM and TPP, the origin of which is not entirely clear at this point. From the fact that PDPMA and the dyes showed no sign of phase separation, the aggregation of dye does not seem to be the reason for causing the reduction of the surface waves.

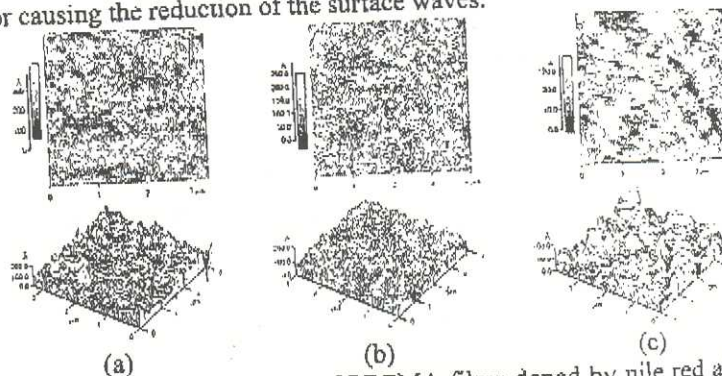


FIGURE 4. AFM images of PDPMA films doped by Nile red at the concentration of (a) 0.1 wt%, (b) 0.5 wt%, and (c) 1.0 wt%.

#### ACKNOWLEDGEMENT

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#### REFERENCES

- [1]. J. Kalinowski, *J. Phys. D: Appl. Phys.* **32**, R179 (1999).
- [2]. T. Sano, Y. Hamada, and K. Shibata, *IEEE J. of Selected Topics in Quantum Electronics*, **4**, 34 (1998).
- [3]. Y. Sato, S. Ichinosawa, and H. Kanai, *IEEE J. of Selected Topics in Quantum Electronics*, **4**, 40 (1998).