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Characteristics of Organic EL Device using PDPMA and Heat-Treated 8-Hydroxyquinoline-Zinc Complex

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Poly(*N*-(*p*-diphenylamine)phenylmethacrylamide (PDPMA) as a polymer hole transporting material and 8-hydroxyquinoline-zinc complex (Znq_2) as an emitting material were synthesized and the organic electroluminescent (EL) device consisting of ITO/PDPMA/Znq_2/Al was fabricated. The chemicophysical and luminescent properties of Znq_2 were significantly influenced by thermal heat treatment. Especially, EL device composed of heat-treated Znq_2 at 200℃ for 3 h emitted orange light with high brightness of 830 cd/m^2.

Keywords: PDPMA; Znq_2; chemicophysical; luminescent; thermal heat treatment

INTRODUCTION

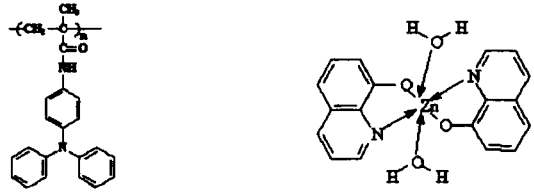
Organic electroluminescnet (EL) devices have attracted much attention due to their application as flat-panel display as well as scientific interest. In general, metalloquinolate compounds have been used as the best emitting materials for stable film formation, good carrier transport and high heat resistance [1].

In this study, we have investigated the properties of organic EL device using PDPMA as a polymer hole transporting material and heat-treated Znq_2 as an emitting material. Especially, the effects of heat treatment for Znq_2 on EL characteristics were studied.

MATERIALS AND EXPERIMENTAL

The synthetic procedure of Znq_2 is as follow: A 8-hydroxyquinoline 26.0 g (0.2 mol) was added in round flask containing ethanol 75 ml. An aqueous solution of zinc chloride 13.3 g (0.1 mol) was dropped into the flask for 30 min followed by refluxing for 3 h on a hot water bath. The reaction mixture was poured into a large amount of distilled water. The precipitated Znq_2 was filtered off and dried under vacuum oven for 24 h. Znq_2 was purified by recrystallization from chloroform and ethanol (yield: 89%). The product was identified as Znq_2 through elemental analysis and spectroscopic measurements such as NMR (Varian Gemini 300 MHz FT-NMR), FT-IR (MIDAC Prospect IR) and GC-MS (Micromass Trio-2000). The chemical structures of the materials used for LED fabrication were shown in Figure 1.

ITO coated glass (20 Ω) was cleaned ultrasonically with a series of organic solvents prior to use. The PDPMA film was spin-cast from a monochlorobenzene solution onto the ITO coated glass. Znq_2 and Al were deposited by a ULVAC VPC-200F evaporator at a pressure below $1X10^{-5}$ Torr. PL and EL spectra obtained from the measurements of an Acton 300i spectrofluorometer. Surface morphology was investigated with a Hitachi S-2500C SEM.

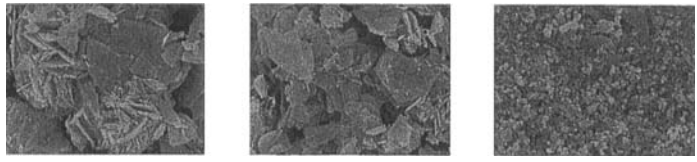


(a) (b)

FIGURE 1 Structures of (a) PDPMA and (b) Znq_2.

RESULTS AND DISCUSSION

In order to explore the thermal history of Znq_2, thermal heating to Znq_2 was carried out at 100℃, 150℃, 200℃ and 250℃ for 3 h, respectively. Scanning electron micrographs of heat-treated Znq_2 were shown in Figure 2. A significant change in particle size was observed at heat treatment of 200 ℃.



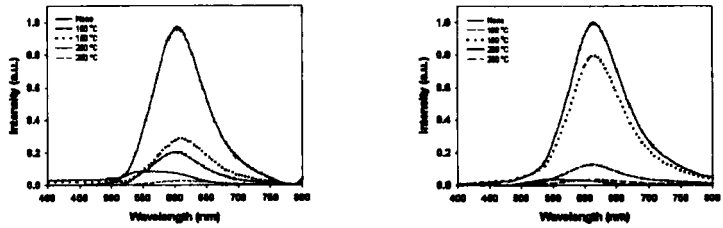
(a) none (b)100℃ (c)200℃

FIGURE 2 SEM micrographs by the heat treatments of Znq_2.

Figure 3 showed the PL and EL spectra organic EL devices using heat-treated Znq_2. As the temperature of heat treating increases until 200 ℃, the fluorescence intensity increased. It may be argued that this behavior is perhaps attributable to reduced interactions between lumophores, corresponding to reduced excimer formation and suppressing aggregates. Especially, the heat treatment leads to a red shift in the maximum emission peak of Znq_2 due to the elimination of

water. On further heating 200 ℃, the fluorescence intensity dramatically decreased because of the thermal degradation of Znq_2.

I-V characteristics of the EL devices were shown in Figure 4. Drive voltage decreased with increase of heat treating temperature, indicating that the decrease in particle size by the heat treatment enhances the carrier mobility of Znq_2.



(a) (b)

FIGURE 3 (a) PL and (b) EL spectra of ITO/PDPMA/heat treated Znq_2/Al devices.

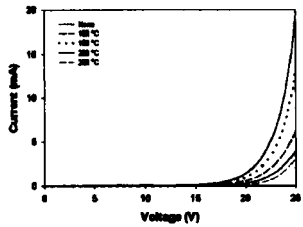


FIGURE 4 Current-voltage characteristics of ITO/PDPMA/heat treated Znq_2/Al devices

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References

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