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Chang Ho Lee [a] , Seung Wook Kim [a] & Se Young Oh [a]

[a] Department of Chemical Engineering, Sogang University, Seoul, 121-742, Korea

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Structural Effects of TDAB Amorphous Hole Transporting Materials on Performance of Organic EL Device

CHANG HO LEE, SEUNG WOOK KIM and SE YOUNG OH

Department of Chemical Engineering, Sogang University, Seoul, 121-742, Korea

For the fabrication of high stable organic electroluminescent device, we have synthesized amorphous molecular materials such as 1,3,5-tris(phenylphenylamino)benzene (TDAB), *p*-ClTDAB, *p*-BrTDAB and *p*-MetTDAB as hole transporting materials and investigated ITO/*p*-XTDAB (X=Br, Cl, methoxy)/Alq_3/Al device emitted green light. It has been found that organic EL device consisting of ITO/*p*-BrTDAB/Alq_3/Al showed high EL intensity. Especially, the durability and EL performance of organic EL device using the amorphous hole transporting material were studied.

Keywords amorphous hole transporting materials; EL intensity; drive voltage; durability

INTRODUCTION

Recently, a great deal of progress in improving the performance of organic electroluminescent device has been achieved. However, low molecular-weight organic charge transporting materials generally tend to crystallize readily[1]. In the previous works, we have reported that the preparation and properties of *p*-BrTDAB amorphous molecular

material with high glass transition temperature as hole transporting material[2].

In this study, we have synthesized *p*-XTDAB amorphous molecular materials with various substituents (Br, Cl, methoxy) and investigated the structural effects of their substituents on thermal and optoelectrical properties.

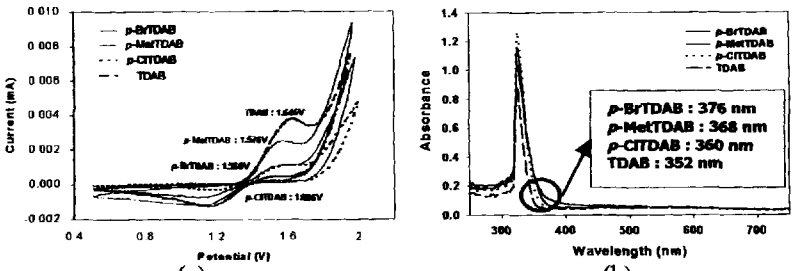
MATERIALS AND EXPERIMENTAL

p-XTDAB (X=Cl, Br, methoxy) was synthesized by Ullmann reaction of 1,3,5-tris(phenylamino)benzene prepared with aniline, phloroglucinol and 4-chloroiodobenzene. The prepared product was purified by column chromatography using a silica gel and was identified as *p*-XTDAB through element analysis, spectroscopic measurements. HOMO level was estimated by CV (IM6) and UV-Visible (Jasco UV 570), respectively.

The *p*-XTDAB film as a hole transport layer was spin-casted from a monochlorobenzene solution onto the ITO coated glass. The speed of spin casting was about 2000 rpm. Alq_3 and Al were deposited by a ULVAC VPC-200F evaporator at a pressure below $1x10^{-5}$ Torr. PL and EL spectra were obtained from the measurements of an Acton 300i spectrofluorometer. The morphology of *p*-XTDAB and TDAB were observed with an Auto Probe PSI AFM.

RESULTS AND DISCUSSION

Cyclic voltammetry curves and UV-Visible spectra of TDAB and *p*-XTDAB (X=Cl, Br, methoxy) were shown in Figure 1 (a) and (b), respectively. We have investigated HOMO and LUMO levels of each amorphous molecular materials. It has been found that *p*-BrTDAB has the highest HOMO level.



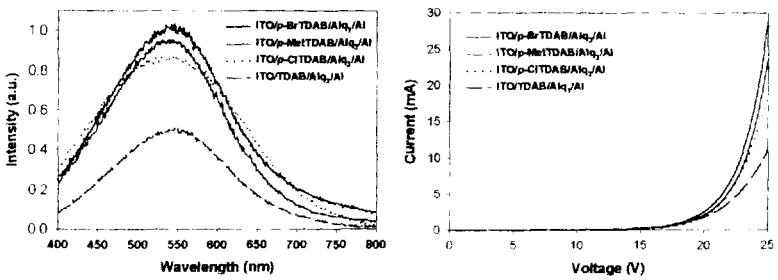
(a) (b)

FIGURE 1 (a) Cyclic voltammetry and (b) UV-Visible spectra of TDAB and *p*-XTDAB.

Figure 2 showed the EL spectra and I-V characteristics of the EL devices consisting of ITO/TDAB or *p*-XTDAB/Alq_3/Al. The EL device using *p*-BrTDAB exhibited high EL intensity and low drive voltage. It may be argued that this behavior is mainly due to the highest HOMO level and improvement of interface property.

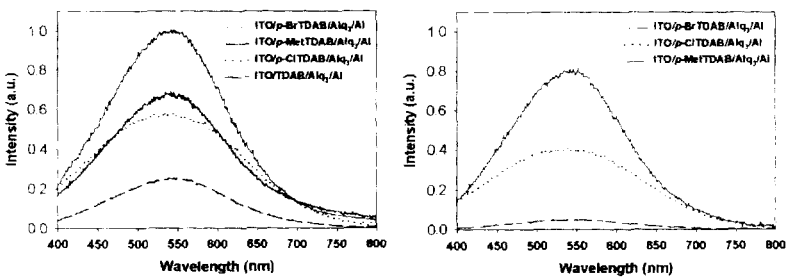
Figure 3 showed the durability of EL device using *p*-BrTDAB was much better than that of EL device using TDAB. This phenomenon may be caused by the morphological stability of *p*-BrTDAB. The surface morphology of *p*-BrTDAB was not changed upon the heat treatment of 90 °C for 8 hrs.

Thus, it has been found that *p*-BrTDAB is an effective hole transporting material.



(a) (b)

FIGURE 2 (a) EL spectra and (b) I-V characteristics of ITO/TDAB or *p*-XTDAB/Alq_3/Al.



(a) 45 °C (b) 90 °C

FIGURE 3 EL characteristics of ITO/TDAB or *p*-XTDAB/Alq_3/Al after heat treatment for 8 hrs at (a) 45 °C and (b) 90 °C.

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