

유 기 발 광 섬 유

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Organic light emitting filaments

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1. Introduction

Organic light-emitting device have attracted much interest due to their potential application in large area, full color, flat panel displays. Poly(p-phenylene)(PPP), as a blue light-emitting materials, have studied in our previous report. Thus, we selected poly(p-phenylene) (PPP) to fabricate the organic light-emitting filaments(OLEF) [1-2]. In this paper, we fabricated an organic light-emitting filaments(OLEF) , which can be woven into fabric. The key concept was flexibility in one-dimensional structures.

2. Experimental

To fabricate organic light-emitting filaments which is flexible and thin, we used Ag filaments with a 0.1mm thick as a cathode. Poly(p-phenylene) (PPP) whose synthesized by Yamamoto method[2] is prepared by vacuum deposition onto Ag filaments. The hole transporting layer of N,N'-diphenyl-N-N'-bis(3-methylphenyl)-1,1-biphenyl-4-4'-diamine(TPD) and hole injecting layer of copper(II) phthalocyanine(CuPc) were used to enhance the hole mobility and luminescence efficiency. The poly(3,4-ethylenedioxythiophene)(PEDOT):poly(4-styrene sulfonate)(PSS) (Baytron P, received from Bayer Co., Germany) layer, a higher work function (5.0eV) than that (4.8eV) of ITO allows hole to be injected easily into the emitting layer, was used as a transparent electrode. We cannot measure the optical and electronic properties in form of light-emitting filaments. Thus we fabricated the flat device (PEDOT:PSS/CuPc/TPD/PPP/Ag). The film roughness and thickness was measured with a atomic force microscopy (AFM, TopoMetrix). The absorption spectra of the film were investigated with a Shimadzu UV-Vis spectrophotometer. The PL and EL spectra were measured with a Shimadzu spectrofluorophotometer(RF-540). The J-V-L characteristics and QE(quantum efficiency) were measured using a Keithley 2000 multimeter equipped with a calibrated Si photodiode (Hamamatsu Photonic)

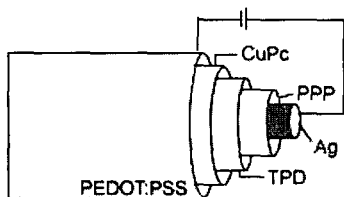


Fig. 1. Schematic diagram of the OLEF

3. Results and Discussion

The PL spectrum of PPP powder, vacuum deposited thin film of PPP and optical absorption spectra of the and PPP powder are shown Fig. 2. The optical absorption has a peak at 314nm which is corresponding to the π - π inter bond transition of PPP. The vacuum deposited PPP spectrum exhibits stronger PL intensity at shorter wavelengths, compared with the PPP powder. This results are attributed to narrow distribution of

shorter conjugation lengths in the vacuum-deposited PPP.

In Fig. 3, EL spectra for the two different device, vacuum deposited PPP/Ag and CuPc/TPD/PPP/Ag, are shown. The spectrum are normalized at the peak wavelength. The EL spectra for the CuPc/TPD/PPP/Ag has a main peak at 444nm, compared with the PPP/Ag device main peak at 446nm.

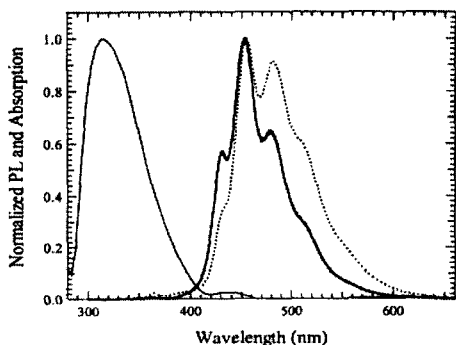


Fig. 2. The PL spectra of the PPP power (dotted) and the PL (thick solid line) and optical absorption spectra(thin solid line) of the vacuum deposited PPP thin film.

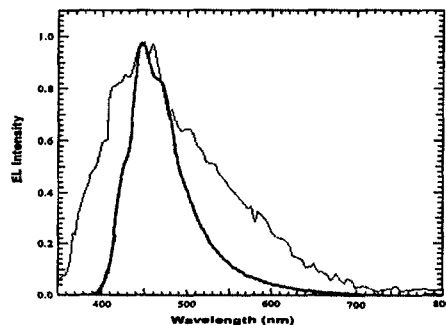


Fig. 3. EL spectra for vacuum deposited PPP/Ag(thick solid line) and CuPc/TPD/PPP/Ag(thin solid line)

Fig. 4. shows the J-V-L characteristic and QE of CuPc/TPD/PPP/Ag. By insertion of CuPc and TPD with the high hole mobility yielded result of stability of the device and eliminates the leakage current, but it increased the turn on voltage about 10-11V. The CuPc/TPD/PPP/Ag device has a enhanced external QE of about 0.05%, compared with a 0.02% of PPP/Ag device.

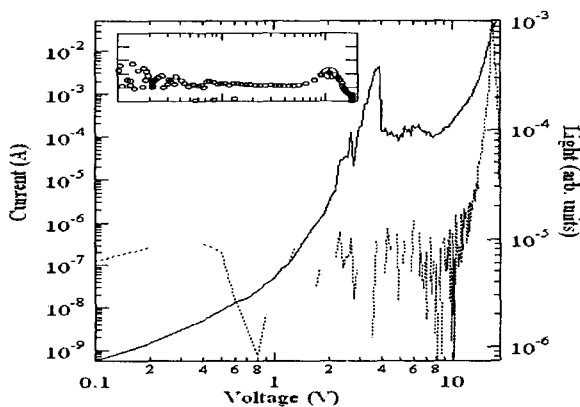


Fig. 4. The J-V-L characteristic and QE of CuPc/TPD/PPP/Ag device.

4. Conclusions

Organic light emitting filaments was fabricated using poly(p-phenylene) as a emitting layer. To fabricate the OLEF, we used PEDOT:PSS as a transparent electrode and hole transporting layer, CuPc, TPD, were used for raise the hole mobility and quantum efficiency. The external QE for CuPc/TPD/PPP/Ag device was increased up to about 0.05%, compared with the PPP/Ag device. OLEF can be woven into fabric with a enhanced luminance and QE.

Acknowledgement

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5. References

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2. Won-Jun Song, Chang Seoul, Gi-Wook Kang and Changhee Lee, *Synthetic Metals, Volume 114, Issue 3, 1 September 2000, Pages 355-359*