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Improved performance of DB-PPV based Polymer Light Emitting Diodes by Thermal Annealing

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1. Introduction

The polymer light emitting diode (PLED) has a great potential for application in optoelectronic devices, especial in flat panel display. There are different research about PLED. Some were focus on the optimum charge-carrier mobility for a polymer light-emitting diode [1]. Some aimed at performance of PLED by metal cathode partial oxidized effect [2]. Some were in research of improved operational stability of PLED [3]. Some were care about the orientation of poly(p-phenylene vinylene) [4].

The 2,3-dibutoxy-1,4-phenylene vinylene (DB-PPV) thin film base polymer light emitting diode (PLED) was firstly reported for using as electroluminescent devices in the year of 1999 [5]. In this sudy, the DB-PPV films are annealed at various temperatures, from below T_g to higher than T_g. After being annealed, the PLEDs are fabricated by these DB-PPV films. The performance of PLED is improved. We can get the best operational properties of PLED fabricated with DB-PPV.

2. General Instructions

Experiments

The DB-PPV powder was solved into toluene and stirred for 24 hours to make the polymer solution. In this study, we had used commercial ITO glass as substrate for PLED's fabrication. The commercial ITO glass substrates had been etched for patterning the anode firstly. The etched ITO glasses were spun with PEDOT as hole transferring layer. The DB-PPV thin films were spun on the substrates. Before PLED were fabricated, the DB-PPV films were annealed on various temperatures 110°C, 130°C, 150°C, and 190°C for one hour. The annealed DB-PPV spun on etched ITO glasses were continued to be deposited Al as cathode and finished the devices.

Result and Discussion

The PLED devices were made after DB-PPV films were annealed. The curve of current-density to bias voltage is shown in Figure 1. From the figure, the turn-on voltage of device for being annealed at 150°C is the lowest compared with other devices annealed at different temperatures.

The luminescent curves of these devices were measured in Figure 2. The PLED which was annealed at 150°C shows the best luminescence than other PLEDs annealed at different temperatures.

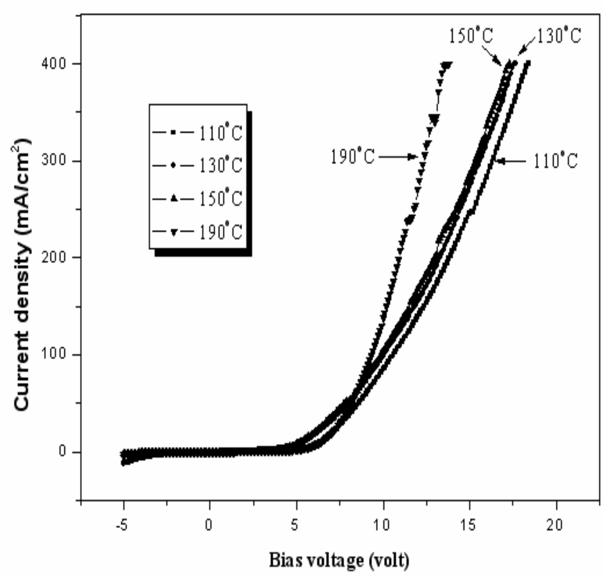

Figure 1 the curve of current density vs. voltage of DB-PPV based polymer light emitting diodes after annealing at various temperatures. It is clearly that the device after annealed at 150°C has the lowest turn on voltage.

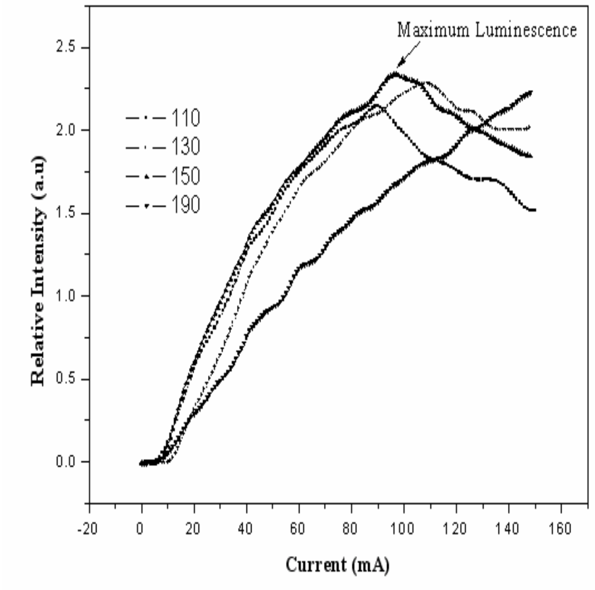

Figure 2 is the curve of luminescence vs. current of DB-PPV film after being annealed at various temperatures. It is obviously that the device after annealed at 150^{o}C has the best luminescence.

Table I Luminescent efficiency

Current(mA)	110^{o}C	130^{o}C	**150^{o}C**	190^{o}C
10	0.012	-	**0.01**	0.005
20	0.028	0.016	**0.030**	0.0145
30	0.029	0.021	**0.032**	0.0164
40	0.031	0.027	**0.033**	0.0188
50	0.029	0.028	**0.031**	0.0186
60	0.029	0.027	**0.030**	0.0194
70	0.027	0.026	**0.028**	0.0185
80	0.025	0.025	**0.026**	0.0182
90	0.023	0.023	**0.025**	0.0174
100	0.019	0.022	**0.023**	0.0171

3. Conclusions

The DB-PPV thin films were deposited by spin-coating on commercial doped ITO glass substrates. These films had been annealed at various temperatures. They had been made to polymer light emitting diodes. Between these annealed temperatures, the PLED that had been annealed at 150^{o}C had got the best performance of electrical and optical properties. The PLED show the best luminescence efficiency and lowest turn on voltage of those PLED that were annealed at other temperatures.

Acknowledgements

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References

[1] P. W. M. Blom, M. C. J. M. Vissenberg, J. N. Huiberts, H. C. F. Martens, and H. F. M. Schoo, Appl. Phys. Lett., 2057, 77 (2000).

[2] G. G. Andersson, M. P. de Jong, F. J. J. Janssen, J. M. Sturm, L. J. van IJzendoorn, A. W. Denier van der Gon, M. J. A. de Voigt, and H. H. Brongersma, J. Appl. Phys., 1376, 90 (2001).

[3] J. S. Kim, R. H. Friend, and F. Cacialli, Appl. Phys. Lett., 3084, 74 (1999).

[4] D. Commoretto, E. Marabelli, P. Tognini, A. Stella, J. Cornil, D.A. dos Santos, J.L. Bredas, D. Morses, and G. Dellepiane, Synthetic Metal, 53, 124 (2001).

[5] F. Cacialli, B.S. Chuah, J.S. Kim, D.A. dos Santos, R.H. Friend, S.C. Moratti, A.B. Holmes, and J.L. Bredas, Synthetic Metal, 924, 102 (1999).