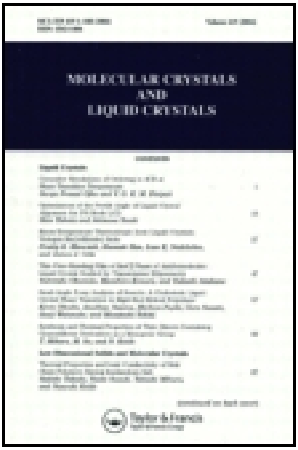

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Organic/Inorganic Hybrid Electroluminescent Devices Prepared *via* Sol-Gel Process

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Organic/inorganic hybrid thin film was introduced into organic electroluminescent device (ELD) in order to enhance the device stability. The inorganic network structure was prepared via sol-gel reaction from tetraethoxysilane (TEOS) in the presence of water. 4-(Dicyanomethylene)-2-methyl-6-(4-dimethylaminostyryl)-4H-pyran(DCM) was used as an organic lumophore. The ELD was fabricated in a simple structure of anode/hybrid layer/cathode. The turn-on voltage of the ELD was *ca.* 30 Vdc with the strong emission at 40 Vdc. The color of the emitted light was light green, meaning a blue shift from the color of the respective solution.

Keywords: organic/inorganic hybrid thin film, electroluminescent device (ELD), sol-gel reaction, lumophore, blue shift

INTRODUCTION

The organic light-emitting diodes (LEDs) or electroluminescent devices

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(ELDs) have attracted much attention due to their potential application to flat panel display[1]. There have been extensive studies on organic ELD to achieve high brightness and multicolor emission as well as to improve the durability of the device. So far, since all ELDs are based on organic layers including emission and hole or electron transporting layers, it is not easy to enable the device to be durable because of intrinsically flexible and soft characteristics of the organic materials.

To overcome these problems, the organic/inorganic hybrid layer, composed of silicon-based sol-gel glass as an inorganic matrix and a molecularly dispersed organic emitter, was used in the present study. The sol-gel glass layer possesses a number of desirable characteristics such as high thermal stability, ability to reduce the translational, rotational, and vibrational degrees of freedom of the trapped dye, and good transparency[2].

EXPERIMENTAL

1.04 g of TEOS and 0.778 g of ethanol were mixed together followed by the dropwise addition of 0.18 g of acqueous 1N HCl solution while stirring gently. Further stirring of this mixture was performed for 12 hr. Following this, 0.0040 g of DCM and 1 g of dimethylacetamide (DMAC) were added to the viscous sol solution and stirred again for 3 days. The well-mixed solution was spin-coated onto the patterned ITO glass followed by soft-baked for 4 hr at 50 °C. The soft-baked film was overcoated with aluminum in a vacuum of 2×10^{-6} torr. The active emission area of the ELD was 3 mm × 3 mm. The ELD structure and the chemical formula of the lumophore used in this study are shown in Figure 1.

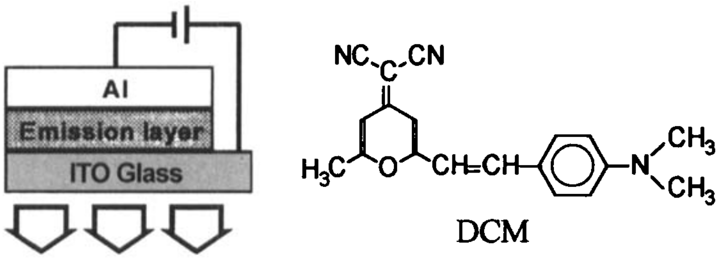

FIGURE 1 The ELD structure and the chemical formula of DCM

RESULTS AND DISCUSSION

The variation of current density with bias voltage of the ITO/DCM-doped sol-gel film/Al device is shown in Figure 2 (a). The injection of current is seemed to be initialized at around 5 Vdc, but the current is almost ohmic below *ca.* 30 Vdc because of the linear increase in current density representing a good resistance. Above 30 Vdc, the current injection is exponentially increased, leading to a diode-like characteristic. In Figure 2 (b), the EL intensity of the device was appeared with the bias voltage. At *ca.* 30 Vdc, the device was started to emit light, and increased fastly above *ca.* 35 Vdc. The EL intensity behavior is in accordance with that of the current density except the ohmic current below 30 Vdc. The emission color observed with naked eyes from the device was, unexpectedly, light green at *ca.* 40 Vdc, which was not red of the DCM observed commonly[3]. However, it is not surprising because the blue shift was occurred due to the dilution effect of the DCM by sol-gel glass.

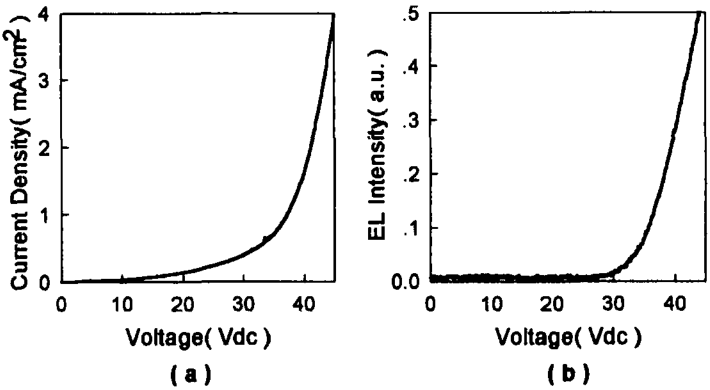

FIGURE 2 (a) Variation of current density of ELD with bias voltage; (b) dependence of EL intensity of ELD on bias voltage.

CONCLUSIONS

The organic/inorganic hybrid ELD was successfully fabricated through sol-gel process. The bright light green light was emitted from the ELD at *ca.* 40 Vdc with the turn-on voltage of *ca.* 30 Vdc. It was not surprising but unexpected that the color of the EL was light green, which may be the color of the very diluted DCM in the sol-gel glass. It is stressed, however, that the intensity of the light was very strong in spite of the very low concentration of lumophore in the present hybrid system.

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