

High Luminance in Organic Electroluminescent Devices with
Bis(10-hydroxybenzo[h]quinolinato)beryllium as an Emitter

Yuji HAMADA,* Takeshi SANO, Masayuki FUJITA, Takanori FUJII,
Yoshitaka NISHIO, and Kenichi SHIBATA

Functional Materials Research Center, Sanyo Electric Co., 1-18-13, Hashiridani, Hirakata, Osaka 573

An organic electroluminescent (EL) devices with bis(10-hydroxybenzo[h]-quinolinato) beryllium (Bebq₂) as an emitter was fabricated. A device structure of [ITO / hole transport layer / emitting layer / MgIn] was employed. Its color was green, and its emission peak was 516 nm. This device offered high performance with a luminance of 1.9×10^4 cd/m² and a luminous efficiency of 3.5 lm/W.

Organic EL devices are expected to serve as a new type of flat display.¹⁾²⁾ These are injection type devices and have a low drive voltage of less than 10 V. Their performance is influenced by an organic emitting material. To be practical, organic EL devices need organic materials which exhibit both a high luminance and a high luminous efficiency, because device with high performance have good endurance. Conventionally, tris(8-hydroxyquinolinato)aluminum (Alq₃)¹⁾ has been considered to be the most excellent emitting material for organic EL devices. Although Alq₃ has low fluorescence efficiency, it offers excellent properties as an emitting material, namely, highly stable film formation, high carrier transport capability, and good heat resistance. In this paper, we report that Bebq₂ which was newly synthesized as an emitting material exhibits higher performance in EL properties than Alq₃.

Bebq₂ was prepared as follows : bq (8 mmol) was dissolved in 40 ml of ethanol-methanol (1:1) in a flask. BeSO₄ 4H₂O (4 mmol) was dissolved in 100 ml of pure water in another flask. The bq solution was slowly poured into the BeSO₄ solution while stirring. Bebq₂ was deposited after the mixed solution was adjusted to pH 10 using NaOH. The Bebq₂ was filtered and purified by the train sublimation method.³⁾ Bebq₂ could be easily sublimated because it was inner complex salt. [Element analysis : H 4.12 (4.05), C 78.64 (78.57), N 6.97 (7.05), () calcd]. The chemical structure of Bebq₂ is shown in Fig. 1.

The EL devices were fabricated using conventional vacuum vapor deposition in a 1.3×10^{-4} Pa vacuum. The device structure was [ITO / hole transport layer (500 Å) / emitting layer (Bebq₂, 500 Å) / MgIn (10:1, 2000 Å)]. The emitting area was 2x2 mm².

The hole transport layer was composed of N, N'-diphenyl-N, N'-(3-methylphenyl)-1, 1'-biphenyl-4, 4'-diamine (TPD).

The luminance of the EL device was measured with a luminance meter and the EL spectrum was measured with a spectrophotometer.

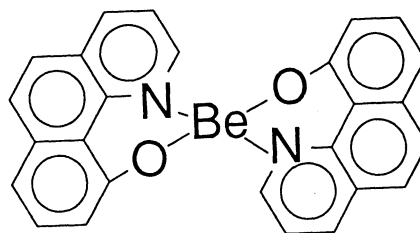


Fig. 1. The molecular structure of Bebq₂.

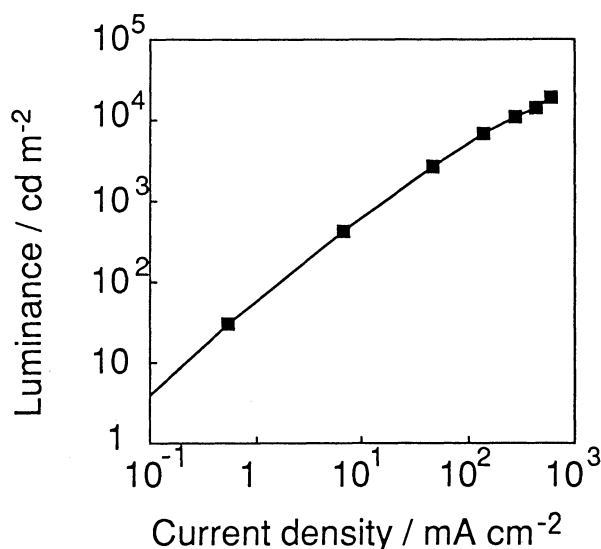
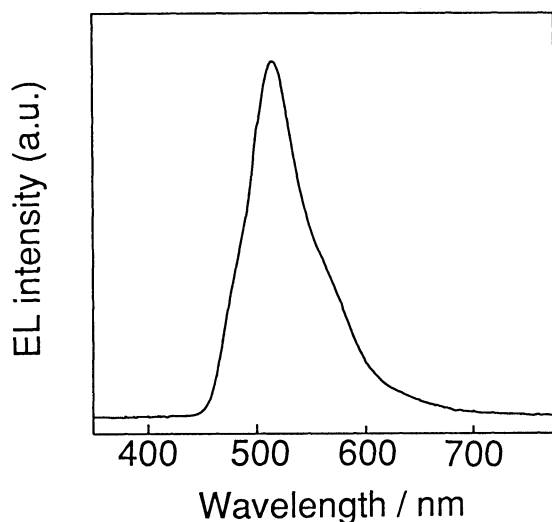


Fig. 2. The EL spectrum of the EL device with Beq₂. Fig. 3. The luminance-current density characteristics of the EL device with Beq₂.

The photoluminescence (PL) spectra of Beq₂ films (1000 Å) were measured with a fluorescence spectrophotometer. All measurements were carried out at room temperature in air.

The deposited Beq₂ films were amorphous and had a good heat resistance because Beq₂ has a high melting point (368 °C). The quality of the Beq₂ films was uniform and fine, and no crystallization was found on the films after deposition. The fluorescence of the Beq₂ films was green, and their PL peak wavelength was 515 nm. The EL spectrum of the device is shown in Fig. 2. The EL color of the device was green, and its EL peak wavelength was 516 nm. Its spectral half-line-width was 64 nm, which is narrower than that of Alq₃. The EL and PL peaks of Beq₂ were almost identical, indicating that the emissions originated from the emitting layer.

The luminance-current density characteristic of the EL device with Beq₂ is shown in Fig. 3. The luminance was proportional to the injection current in the region of 1-10² mA/cm², indicating that Beq₂ has good electron transport capability in a two-layer device structure. The maximum luminous efficiency of the device was 3.5 lm/W at a luminance of 1.2×10² cd/m². This luminous efficiency is superior to that of Alq₃ (1.5 lm/W).¹⁾ The maximum luminance was 1.9×10⁴ cd/m², which is also superior. The PL intensity of Beq₂ films was 2.6 times stronger than that of Alq₃ in the same film thickness (1000 Å). It seems that the device with Beq₂ exhibits high-performance because Beq₂ has higher fluorescence efficiency.

We expect that Beq₂ will be used for an organic EL device as a new emitting material which has both high luminance and high luminous efficiency.

References

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