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Synthesis of Metal Complexes Chelated with N-Naphthalenyl Aminomethyl Phenol and Their Application to OELD

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The metal complexes chelated with N-naphthalenyl aminomethyl phenol were synthesized and the beryllium complex was applied to the organic electroluminescent devices as a blue light-emitting layer. Emission wavelength was observed at 406nm in luminescence spectra for this complex. Its ionization potential (IP), electron affinity (EA) and band gap were investigated with cyclic voltammetry and found to be consistent with their UV-vis absoption spectral data.

Keywords N-naphthalenyl aminomethyl phenol; organic electroluminescent device; blue light-emitting layer; band gap; cyclic voltammetry

INTRODUCTION

Organic electroluminescent devices (OELD) have been actively developed in recent years and now these devices are in the stage of practical application. While highly efficient green light emission has been achieved with a device containing AlQ_3 as an emitting layer[1], red and blue light-emitting materials with high efficiency, good color purity

and long-term stability remain yet to be developed for the commercial full color display.

Recently, several boron[2] or aluminum centered complexes[3] have been reported as an efficient blue light-emitting layer in OELD. Parallel to these developments, we would like to report herein that bis-(2-(naphthalen-2-yl-aminomethyl)phenolato) beryllium (Be(β-nap)$_2$) is synthesized and applied to OELD as a blue-light emitting layer. Naphthylamine is known to exhibit strong blue fluorescence upon irradition and thus was employed in this study as a part of the chelating ligand, 2-(naphthalen-2-yl- aminomethyl)phenol (β-napH).

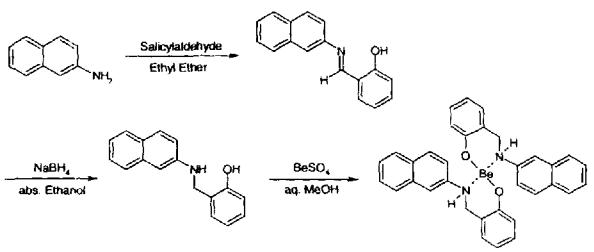


FIGURE 1. Synthesis of bis-(2-(naphthalen-2-yl-aminomethyl)-phenolato) beryllium (Be(β-nap)$_2$)

EXPERIMENTAL

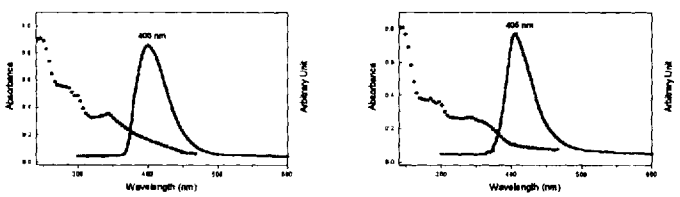
The β-napH (mp 150-152℃) was prepared from condensation reaction of 2-naphthylamine with salicylaldehyde, followed by reduction of the resulting imine with sodium borohydride. Be(β-nap)$_2$ (mp 204-206℃) was then prepared from reaction of $BeSO_4$ (4.4mmol) in 100mL water with β-napH (7.3mmol) in 50mL methanol (Figure 1). The resulting precipitate was filtered and washed with water and cold methanol to

yield Be(β-nap)$_2$ in a 75% yield. Zn(β-nap)$_2$ was prepared by the similar procedure described above. The free ligand and the beryllium complex were characterized with UV-vis, ^{1}H NMR, MS/FAB, photoluminescence (PL) and EL.

RESULTS AND DISCUSSION

Beryllium and zinc complexes were prepared herein from the reaction of Be(II) or Zn(II) ion and β-napH. Be(β-nap)$_2$, but not Zn(β-nap)$_2$, was possible to be sublimed and thus subject to vacuum deposition. The UV-vis absorption and photoluminescence(PL) spectra of Be(β-nap)$_2$ were investigated with its thin film on a quartz substrate.

The maximum PL peak of Be(β-nap)$_2$ was observed at 406nm, being close to the PL peak of the free ligand (Figure 2). It was inferred that the naphthylamine moiety which was known to have strong blue fluorescence greatly contributed to blue light emission displayed by the complex and the free ligand. The bandwidth of the complex was found to be narrower than that of the free ligand.



(a) (b)

FIGURE 2. UV-vis (dotted line) and PL (solid line) Spectra : (a) β-napH, (b) Be(β-nap)$_2$

Cyclic voltammetry of Be(β-nap)$_2$ was also performed with the vacuum deposited sample on glass. This method revealed the IP, EA, and electrochemical gap of Be(β-nap)$_2$, which correspond to its HOMO, LUMO, and band gap, respectively. From these UV-vis absorption edge and cyclic voltammetry results, we found that the optical band gap is in good agreement with the electrochemical gap (Figure 3).

Further studies on fabrication of the electroluminescent device using Be(β-nap)$_2$ as emitting layer are in progress in our laboratory.

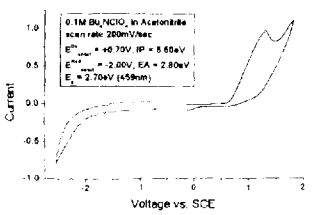


FIGURE 3. Cyclic voltammogram of Be(β-nap)$_2$

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