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Synthesis, Characterization, and Electroluminescent Characteristics of Mixed-Ligand Zinc(II) Complexes

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Mixed-ligand zinc complexes, i.e., 2-(2-hydroxyphenyl)benzothiazolato-5,7-dichloro-8-hydroxyquinolinato zinc(II) [ZnBTZ(Cl_2q)], 2-(2-hydroxyphenyl) benzothiazolato-5,7-dimethyl-8-hydroxyquinolinato zinc(II) [ZnBTZ(Me_2q)], and 2-(2-hydroxyphenyl)benzothiazolato-2-carbonitril-8-hydroxyquinolinato zinc(II) [ZnBTZ(CNq)], were synthesized and characterized. The metal complexes have high thermal stability (>300°C) and high glass-transition temperature (>150°C) and are suitable for optoelectronic applications. Optical properties of the synthesized complexes were characterized by using ultraviolet–visible (UV–Vis) and photoluminescence spectroscopy. Color tuning by changing the ligand was observed in synthesized complexes. Multilayered organic electroluminescent devices were fabricated having structure indium–tin oxide (ITO)/*N*,*N*′-diphenyl-*N*,*N*′-bis(1-naphthyl)-1,1′-biphenyl-4,4′-diamine (α-NPD)/zinc complex/2,9-dimethyl-4,7-diphenyl-1,10-phenanthroline (BCP)/tris(quinolinolate)Al^{III} (Alq_3)/LiF/Al using the synthesized complexes as emissive material. The electroluminescence spectra show peak emission centered at 532 nm, 572 nm, and 541 nm, respectively, for these materials. The emitted light has chromaticity with Commission Internationale d'Éclairage coordinates x = 0.35 and y = 0.56 for ZnBTZ(Cl_2q), x = 0.49 and y = 0.47 for ZnBTZ(Me_2q), and x = 0.48 and y = 0.40 for ZnBTZ(CNq) complex.

Key words: OLED, zinc complex, electroluminescence, mixed ligand

INTRODUCTION

Organic–metal complexes are valued emitters for applications in small-molecule organic light-emitting diodes (SMOLEDs) due to their good stability, easy deposition in thin layers, and good emission-color purity.[1–5] Color tuning is very important for fabrication of full-color displays, and this tuning is possible if substituent groups are chosen properly in the organic part of the electroluminophore. Tris(quinolinolate)Al^{III} (Alq_3) is the most widely used electroluminophore in SMOLEDs, because of its high stability due to a high glass-transition temperature.[6–8] Substituents with electron-withdrawing or electron-donating groups in quinoline ring of Alq_3 enable color tuning of OLED emission.[9–12]

In particular, research on Zn complex as an emitting, as well as electron transport, material has also attracted considerable attention because of the good emissive, electron transport, and thermal properties.[13–16] The electron transport layer plays an important role in transporting electrons and blocking holes, thus preventing holes from moving into the electrode without recombining with electrons.[17] In our laboratory, 8-hydroxyquinoline–zinc complexes with halogen substituted at 5- or 5,7-positions were synthesized and showed hypsochromic

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