DOCTORAL THESIS

New luminescent organometallic complexes of platinum (II), iridium (III), copper (I) and gold (III) and their optoelectronic applications

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New Luminescent Organometallic Complexes of Platinum(II), Iridium(III), Copper(I) and Gold(III) and their Optoelectronic Applications

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Abstract

The molecular design, synthesis, spectroscopic and photophysical characterization of a series of new transition metal Pt, Ir, Cu, Au and Hg-containing complexes containing diimine, carbazole and fluorene units as luminescent chromophores are discussed. The applications of some of these complexes in optoelectronic devices have also been investigated.

Chapter 1 gives a brief overview of the background of organometallic complexes and their role in the fields of organic light emitting diodes (OLEDs).The chemistry and utility of carbazole and bipyridine luminophores in material research are also discussed.

The synthesis and photophysical studies of several multifunctional phosphorescent cyclometalated Pt(C^N)(O^O) complexes consisting of the hole-transporting carbazole luminophores were reported in Chapter 2. Electronic properties of these complexes were influenced by changing the organic groups in the complexes. These triplet emitters are strongly phosphorescent at room temperature with relatively short lifetimes in solution. OLEDs using these complexes have been fabricated with very promising performance. The potential of exploiting some of our green phosphores in the realization of white OLEDs (WOLEDs) is also discussed.

In Chapter 3, the synthetic methodology and characterization of a series of new

platinum(II) α-diimine bis(arylacetylide) complexes with different substituents on the diimine ligands were reported. The photo- and electroluminescence properties of these phosphorescent metalated complexes were studied in terms of the nature of arylacetylide ligands. The impacts of different substituents on the diimine and ancillary arylacetylide ligands upon their emissive behavior were examined to reveal their emission energies can be systematically modified. Intensive room temperature phosphorescence of these complexes which are beneficial to device application are also highlighted here. A series of highly efficient and bright OLEDs have been achieved based on these triplet emitters.

Chapter 4 presents the synthetic methodology and characterization of a series of highly efficient iridium phosphor, with good color tenability, based on the carbazole and fluorene luminophores bearing the dpm or dpa ancillary ligands. The electronic properties of these complexes were greatly influenced by changing the organic cyclometalated ligands in the complexes. These iridium-based triplet emitters give strong phosphorescence light at room temperature with relatively short lifetimes in solution, and OLEDs using some of these complexes were fabricated and showed moderate to very high efficiency. The highly efficient WOLEDs with two-element structure of exploiting some of these new iridium triplet emitters are also discussed.

In Chapter 5, a series of diimine-based heteroleptic Cu(I) complexes were designed and synthesized. Taking advantage of the abundant photophysical properties of diimine ligands, copper(I) ion can be incorporated into the diimine structure to give attractive photoluminescent properties of the complexes, which render them a great potential to excel in optoelectronic devices.

Chapter 6 outlines the synthesis, structural, photophysical, electrochemical and electroluminescent properties of a novel family of cyclometalated gold(III) and mercury(II) complexes. Different kinds of carbazole-containing cyclometalating ligands were introduced to fine-tune their absorption and emissive characteristics of the compounds. The observation of intense room temperature phosphorescence emissions of these complexes which are promising for device applications is also discussed.

Chapters 7 and 8 present the concluding remarks and the experimental details of all the works described in Chapters 2–6.

Table of Contents