Conjugated Metal-Organic Phosphorescent Materials and Polymers Containing Fluorene and Carbazole Units

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Abstract

The molecular design, synthesis, spectroscopic and photophysical characterization of a series of metal-containing polymers and complexes incorporating carbazole and fluorene chromophores are discussed. The applications of some of these complexes in optoelectronics devices and materials science are also outlined.

Chapter 1 contains a brief overview on the background of metal-containing complexes and their role in the fields of organic light-emitting diodes (OLEDs). The chemistry and utility of fluorene and carbazole luminophores in material research is also discussed.

Chapter 2 presents the synthetic methodology and characterization of a series of new metal-acetylide complexes and polymers containing oligocarbazole and oligofluorene and carbazole-fluorene mixed hybrids. The electronic properties of these complexes were greatly influenced by changing the organic spacers in the complexes. The triplet energy was enhanced by the presence of carbazole unit which can act as an effective conjugation-interrupter.

A full account of the preparation, characterization, photophysical and thermal properties of a new series of platinum(II) diimine polymers and complexes are presented in chapter 3. We report the photoluminescence and redox properties of these
metal acetylide compounds in terms of their chain length and ligand variations. The heavy atom effect as well as the attractive photoluminescent properties imposed by the diimine groups in harnessing the phosphorescence emissions render them suitable for the fabrication of polymer light-emitting diodes (PLEDs). Their utilization in the realization of nanoparticle research is also discussed.

In Chapter 4, the synthesis and photophysical studies of several multifunctional phosphorescent iridium(III) cyclometalated complexes consisting of the hole-transporting carbazole and fluorene-based 2-phenylpyridine moieties were reported. The photo- and electroluminescence properties of these phosphorescent metalated complexes have been studied in terms of the nature of cyclometalated ligands. Incorporation of hole-transporting carbazole units in various classes of complexes leads to an increase of the highest occupied molecular orbital levels and hence improves the charge balance in the resulting complexes. These iridium-based triplet emitters give a strong phosphorescence light at room temperature with relatively short lifetimes in the solution phase. Organic light-emitting diodes (OLEDs) using some of these complexes have been fabricated which show moderate to very high efficiencies. The potential of exploiting some of our orange phosphor dyes in the realization of white OLEDs is also discussed.

Chapter 5 outlines the synthesis, structural, photophysical, electrochemical and
electroluminescent properties of a novel family of multifunctional platinum(II) cyclometalated complexes. Different kinds of carbazole-containing cyclometalating ligands were introduced to fine-tune the absorption and emissive characteristics of the compounds. The observation of intensive room temperature phosphorescence emissions of these complexes which are beneficial for device applications are also discussed here.

Chapters 6 and 7 present the concluding remarks and the experimental details of the work described in Chapters 2–5.
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