# MASTER'S THESIS

## Iridium-based organometallic electrophosphors for organic light-emitting devices

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# Iridium-Based Organometallic Electrophosphors for Organic Light-Emitting Devices

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# Abstract

The molecular design, synthesis, spectroscopic, thermal, redox and photophysical characterization of a series of iridium(III)-containing cyclometalated complexes incorporating carbazole, fluorene and main-group moieties are discussed. The applications of some of these complexes in optoelectronic devices and materials science have also been investigated.

Chapter 1 is a brief overview on the background of metal-containing complexes and their roles in the fields of organic light-emitting diodes (OLEDs). The chemistry and utility of fluorene, carbazole and main-group units in materials reseach are also highlighted.

The synthesis and photophysical studies of several multifunctional phosphorescent iridium(III) cyclometalated complexes consisting of hole-transporting carbazole and fluorene-based 2-phenylpyridine chromophores are reported in Chapter 2. The photo- and electroluminescence properties of these phosphorescent metalated complexes have been studied in terms of the cyclometalated ligands. Incorporation of hole-transporting carbazole units is found to increase the highest occupied molecular orbital of the phosphors. These triplet emitters are strongly phosophorescent at room temperature with relatively short lifetimes in solution. OLEDs using some of these complexes have been fabricated with very promising performance. The potential of

exploiting some of our orange phosphors in the realization of white OLEDs (WOLEDs) is discussed.

In Chapter 3, the synthetic methodology and characterization of a series of new iridium(III) cyclometalated complexes consisting of electron injecting/transporting main-group ligands substituted with trifluoromethyl substituent on the pyridyl ring are reported. The photo- and electroluminescent properties of these phosphorescent metalated complexes have been studied in terms of the nature of the cyclometalated ligands. Effects of different main group moieties on the electronic factor were also studied. These iridium-based triplet emitters can give strong phosphorescence at room temperature with relatively short lifetimes in solution. The OLEDs and WOLEDs of selected dyes have been fabricated with high performance.

Chapter 4 outlines the synthesis, structural, photophysical, electrochemical and electroluminescent properties of a novel family of cationic iridium(III) cyclometalated complexes. Different kinds of carbazole-, fluorene- and main-group-containing cyclometalated ligands were introduced to fine-tune the absorption and emissive characteristics of these compounds. Intensive room temperature phosphorescence emission of these complexes which are beneficial to device applications in OLEDs and light-emitting electrochemical cells (LECs) are also discussed.

Chapter 5 and 6 present the concluding remarks and the experimental details of

the work described in Chapters 2-4.

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