DOCTORAL THESIS

Metal-organic compounds of iridium(III) and platinum(II): synthesis, characterization and optoelectronic applications

Wu, Hao

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Abstract

The molecular design, synthesis and characterization of a series of ligands and the corresponding novel iridium(III) or platinum(II) complexes are discussed in this thesis. Their photophysical and electrochemical properties, the applications in organic light-emitting diodes (OLEDs), dye-sensitized solar cells (DSSCs), aggregation induced emission (AIE) and time-resolved infrared (TRIR) study are also investigated.

Chapter 1 generates a brief overview of the background, principle, and development of OLEDs, DSSCs, AIE materials and the involvement of the TRIR technique.

Chapter 2 describes the synthesis, spectroscopic, photophysical and electrochemical characterization of a series of cationic iridium(III) complexes. Strong electron-withdrawing carboxylic acid substituted bipyridyl was involved in the ligand system and the intra-ligand charge transfer character of diphenylamino containing ligand further shift the dominant absorption band to the lower energy region. Some of them were applied for DSSC device fabrication.

Chapter 3 presents the synthesis, spectroscopic, photophysical and electrochemical characterization as well as OLED application of a group of cyclometalated iridium(III) complexes by using 2-substituted 9-benzylcarbazolyl,

9-phenylcarbazolyl or 2-methyl-7-phenylcarbazolyl groups as the ligands. They show significant bathochromatic shift from those using 3-substituted ligands. And this can be explained by the fact that more electron density is located at 2-position of carbazole moiety and make them suitable candidates for deep red OLED application.

Chapter 4 delivers the synthesis, spectroscopic, photophysical and electrochemical characterization of a series of platinum(II) acetylide complexes for AIE study. All of the complexes contain [4-(1,2,2-triphenylethenyl)phenyl]ethynyl ligand, which is designed from AIE active building block tetraphenylamine (TPE). Some of these metal complexes show AIE behavior.

Chapter 5 outlines the synthetic methodology and characterization of another series of cyclometalated iridium(III) and platinum(II) complexes, containing TPE or carbazole units. It is very interesting to find out that there is hardly any emission in all of the TPE-containing cyclometalated complexes, nor any signs of AIE behavior. Meanwhile, for carbazole-containing platinum(II) complexes, remarable AIE results could be generated, which is believed to be important for further organometallic AIE active material development.

Chapter 6 describes the synthetic methodology and characterization of a series of symmetric or asymmetric platinum(II) acetylides. Some of them were

further applied for TRIR analysis to generate detailed experimental information of the electron transitions during excitation. The results demonstrate that both localized and delocalized metal ligand orbital mixing could be generated according to the variations in electronegativity of the ligand system.

Chapter 7 and 8 present the concluding remarks and summarize the experimental details of all of the previous chapters.

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