DOCTORAL THESIS

Design and syntheses of Ir(III) complexes as luminescent biosensors

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ABSTRACT

Luminescent transition metal complexes have attracted tremendous interest in the analytical field. Most luminescent metal complexes possess long emission lifetimes in the visible region, and their phosphorescence can be readily distinguished from short-lived background auto-fluorescence. Moreover, their large Stokes shift can prevent self-quenching, while their modular synthesis allows their properties to be readily tuned without labor-intensive synthetic protocols. These properties render transition metal complexes as promising candidates for the development of biosensors. In this study, I aimed to explore different kinds of Ir(III) complexes that can be used as biosensors to monitor DNA secondary structures or protein conformations.

Chapter 1 gives a brief introduction regarding the luminescence mechanism of transition metal complexes, and the properties, structures and preparations of Ir(III) complexes are also introduced. Chapters 2–4 report the syntheses and screening of Ir(III) complexes, and the use of these Ir(III) complexes to monitor the secondary structure of DNA, such as G-quadruplex, G-triplex and i-motif DNA. Chapter 2 reports the G-quadruplex-selective properties of two luminescent Ir(III) complexes **2.1** and **2.9** for the detection of ochratoxin A (OTA) and nicking endonuclease in

aqueous solution, respectively; Chapter 3 explores a novel Ir(III) complex **3.8** which is highly specific for G-triplex DNA, and was thus employed for Mung Bean nuclease activity detection; Chapter 4 introduces the Ir(III) complex **4.1** that exhibited a high signal enhancement to i-motif DNA, and was therefore used for terminal deoxynucleotidyl transferase (TdT) activity detection. Chapter 5 describes the two novel cyclometalated Ir(III) complexes **5.1** and **5.21** that were used to monitor two kinds of proteins, human serum albumin (HSA) and beta-amyloid(1–40) ($A\beta_{1-40}$), respectively.

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