DOCTORAL THESIS

Organometallic porphyrin based complexes for photophysical and biological application

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Date of Award:
2016

Abstract

This thesis focuses on the development of porphyrin-based complexes as multi-modal bio-imaging probes. Detailed studies of photophysical and biological properties were included.

In chapter 1, the general background of porphyrin and its derivatives, their structure specialty, synthetic methods, photophysical properties, and applications in biological system were described.

Curcumin-bridged porphyrin-copper complex (**Por-Cu-Cur**) which can permeate through the high blood-brain barrier, accumulate fast in brain tissues, and emit brilliant and stable two photon excited emission has been developed. Apart from this, **Por-Cu-Cur** shows high binding affinity for Aβ fibrils, and decent inhibitory effect on the fibrillation of Aβ1-42 peptides, as well as low toxicity to neuro-derived SK-N-SH cells *in vitro* and particularly *in vivo* in transgenic mice.

The design and synthesis of amphiphilic porphyrin linked ruthenium complexes were described. We focus on the photophysical studies of its UV-Vis absorption spectrum, fluorescence spectrum, solvatochromism, and singlet oxygen phosphorescence. The converse energy transfer mechanism of porphyrin-ruthenium complexes and zinc-porphyrin-ruthenium complexes has been clearly studied. Subcellular

localization, dark cytotoxicity and photodynamic therapy has been well studied, which efficiency correspond to the energy transfer mechanism.

Based on the previous study, we would like to provide a proof-of-concept model - labelling (hot/cold) gallium in porphyrin-based complex with a short reaction time (but with high reaction yield) and aim to develop a multi-modal bioprobe for photodynamic therapy, optical imaging and positron emission tomography in one piece. An amphiphilic hot gallium-porphyrin-ruthenium compound has been synthesized (**GaporRu-1**) with reaction time of 15 minute and 85 % yield. The acidity of **GaporRu-1** enables selective subcellular localization in lysosome. It also has an good singlet oxygen quantum yield (61.4 %), which proves its great potential for further *in vivo* study for as both PDT and PET agents

Experimental details are shown in chapter 5. Including details of photophysical measurements, instrumentation and biological measurements.

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