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Synthesis of Novel Hydroporphyrin Organoplatinum Photonics Materials as Activatable Singlet Oxygen Photosensitizers

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Aim

Synthesize a novel class of selectively activatable organoplatinum hydroporphyrin photosensitizers and determine their structure – photophysical relationship

Abstract

Photonic materials that can function as activatable singlet oxygen photosensitizers are of great interest because of their potential applications including *in vivo* imaging and cancer therapy. However, photonic materials based on tetrapyrrolic macrocycles that can selectively be activatable have yet to be reported. The aim of this research is the synthesis of novel hydroporphyrin organoplatinum photonics materials, and investigate the structure-photophysics relationship of such materials. This research would allow us to establish guidelines for the design of selectively activatable singlet oxygen photosensitizers. Further experimentation with syntheses and photophysical properties are currently under investigation. Future plans include the optimization and additional synthesis of other organoplatinum photonics materials while determining their structure – photophysical properties with pertinence to singlet oxygen production.

Introduction

- Tetrapyrrolic Macrocycles - class of bioorganic molecules
- Function as biological pigments with remarkable photochemical and physical properties
- Varying the degree of saturation establishes the macrocyclic sub-classes (Fig. 1)

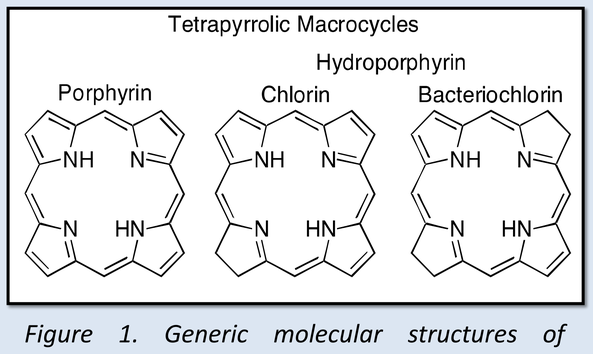


Figure 1. Generic molecular structures of unsubstituted tetrapyrrolic macrocycles. Hydroporphyrins are chlorin and bacteriochlorin.

- Heavy Atom Effect - introduction of a heavy atom substituent group, such as platinum (Pt), enhances spin-forbidden processes
- Increased intersystem crossing into the triplet state could lead to an increase in the production of reactive singlet oxygen species ($^1O_2$).

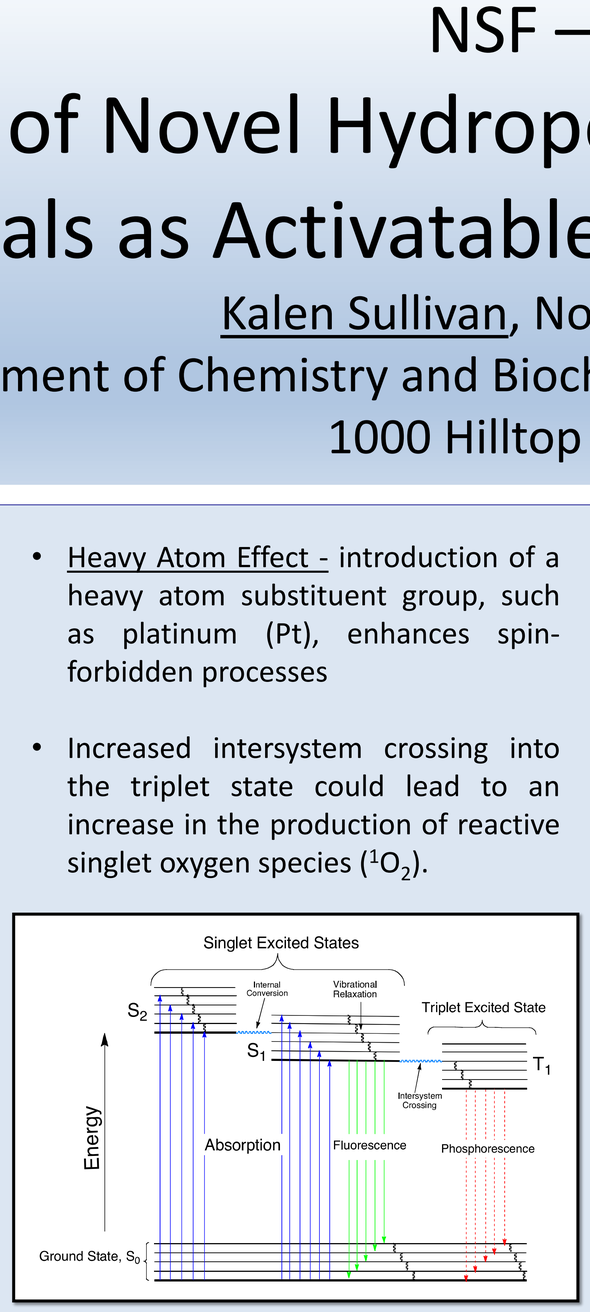


Figure 2. Jablonski diagram depicting the potential electronic transitions within a given molecule.

Results

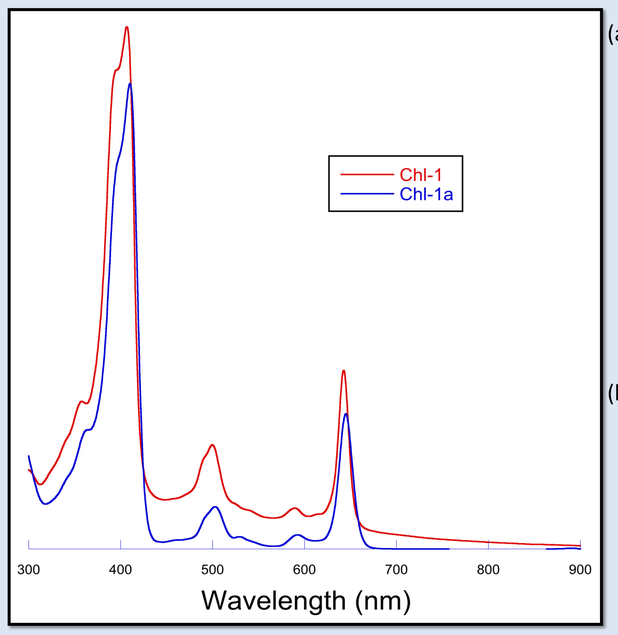


Figure 3. Absorbance (OD) vs. Wavelength (nm) spectrum of Chl-1 and Chl-1a (Scheme 1). A red-shift of 4.0 nm was measured between the Chl-1 and Chl-1a maximum absorbance wavelength, 406.5 and 410.5 nm, respectively.

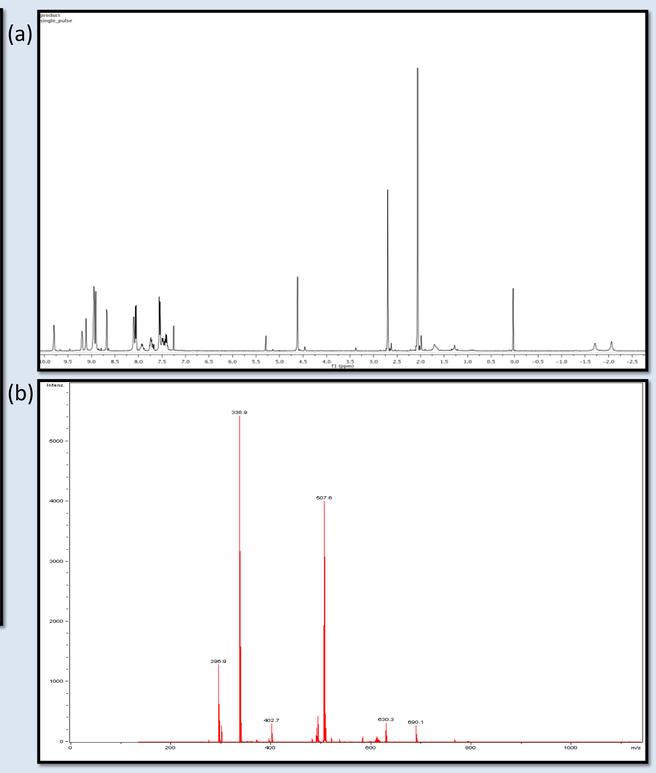
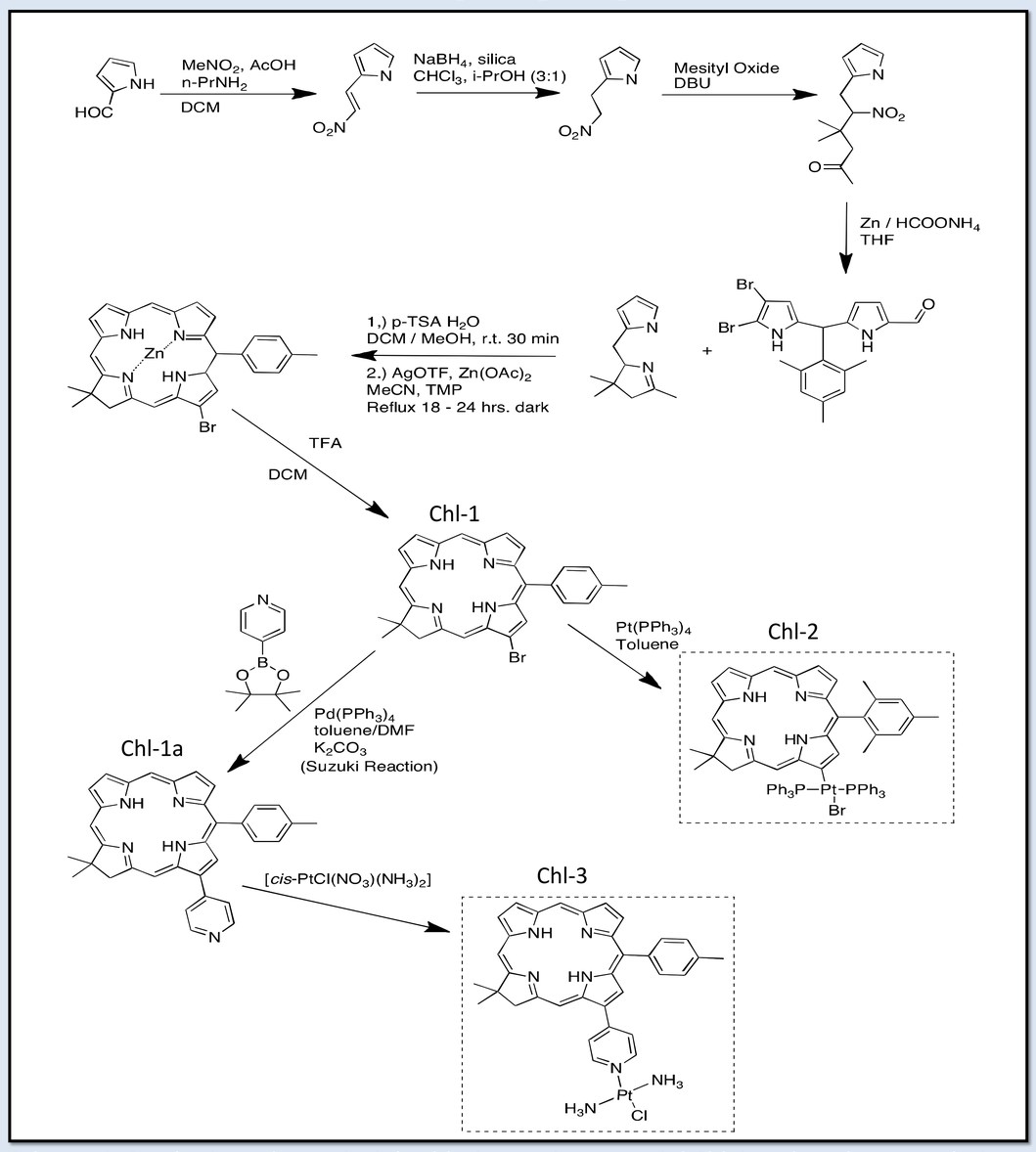


Figure 4. (a) Chl-1a ^1H NMR (b) Chl-1a MALDI – TOF; M + 1 = 507.6 m/z

Experimental Design

Hypothesis: Addition of a Pt moiety will enhance intersystem crossing leading to increased triplet-state excitation and singlet oxygen production

↑ [T_1] + $^3O_2$ → $^1O_2$



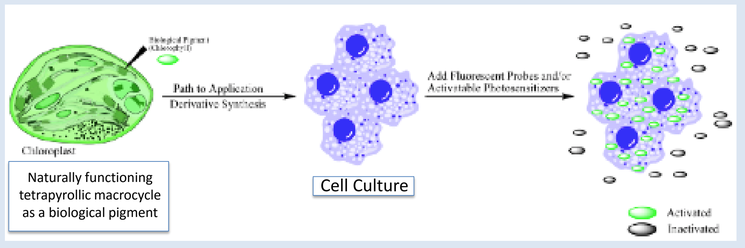
Scheme 1. Synthetic path to principle chlorin starting material Chl-1 and goal organoplatinum hydroporphyrin derivatives Chl-2 and Chl-3.

Conclusions

- Further investigation into the synthesis of organoplatinum hydroporphyrin derivatives Chl-2 and Chl-3 in Scheme 1 is needed to draw significant conclusions

Future Directions

Desired Application: Medical Diagnostics



- Explore additional organoplatinum hydroporphyrin derivatives and their structure – photophysical relationship
- Synthesize and determine the feasibility of other hydroporphyrin derivatives as activatable singlet oxygen photosensitizers

Acknowledgments

Research Experiences For Undergraduates

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