

Water Soluble Cationic Porphyrin Sensor for Detection of Hg²⁺, Pb²⁺, Cd²⁺, and Cu²⁺



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ABSTRACT

Here we report the sensing properties of the aqueous solution of *meso*-tetra(N-methyl-4-pyridyl)porphine tetrachloride (**1**) for simultaneous detection of toxic metal ions by using UV-vis spectroscopy. Cationic porphyrin **1** displayed different electronic absorptions in UV-vis region upon interacting with Hg²⁺, Pb²⁺, Cd²⁺, and Cu²⁺ ions in neutral water solution at room temperature. Quite interestingly, the porphyrin **1** showed that it can function as a single optical chemical sensor and/or metal ion receptor capable of detecting two or more toxic metal ions, particularly, Hg²⁺, Pb²⁺, and Cd²⁺ ions coexisting in a water sample. Porphyrin **1** in an aqueous solution provides a unique UV-vis sensing system for the determination of Cd²⁺ in the presence of larger metal ions such as Hg²⁺, or Pb²⁺. Finally, the examination of the sensing properties of **1** demonstrated that it can operate as a Cu²⁺ ion selective sensor via metal displacement from the **1**-Hg²⁺, **1**-Pb²⁺, and **1**-Cd²⁺.

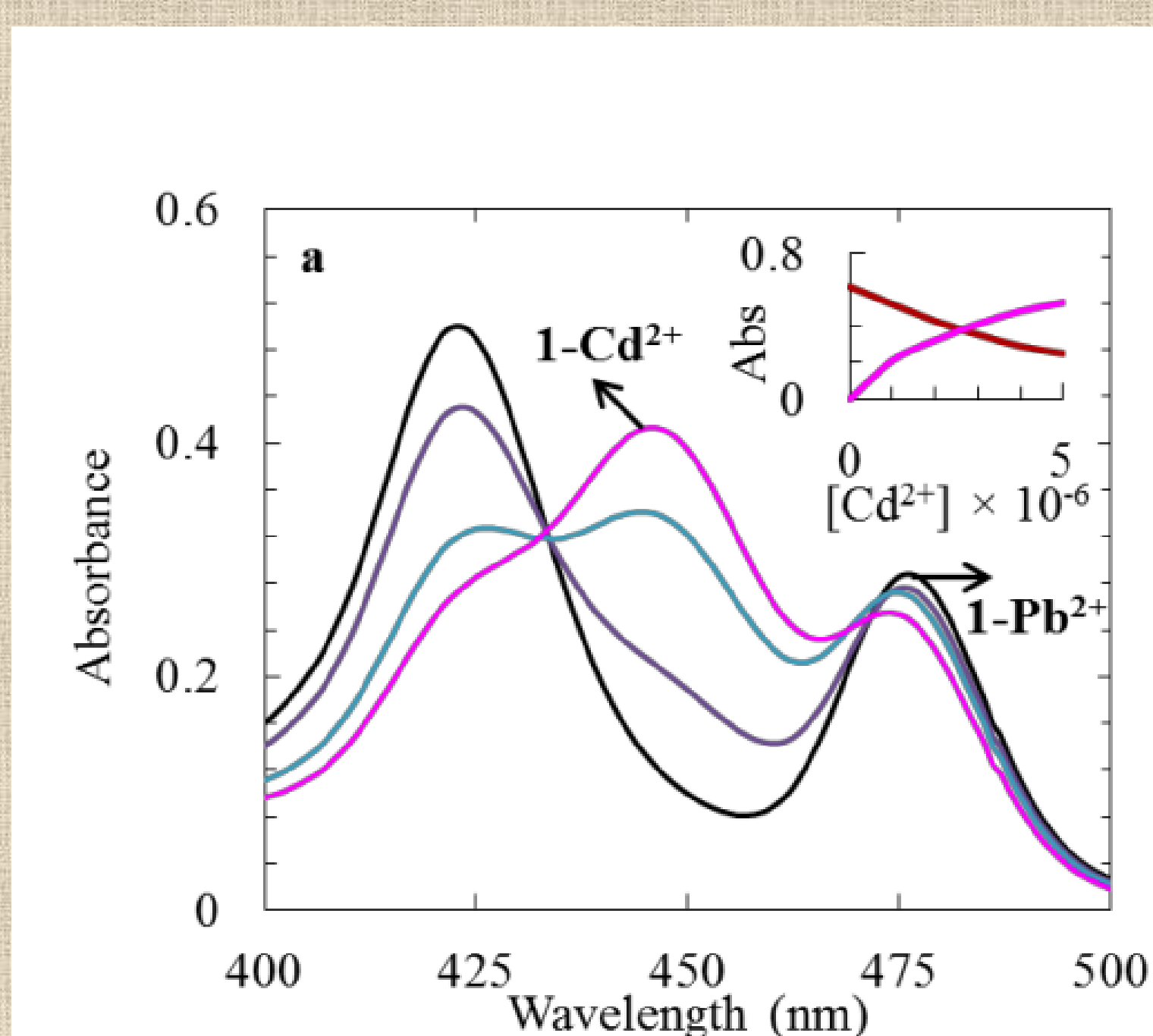
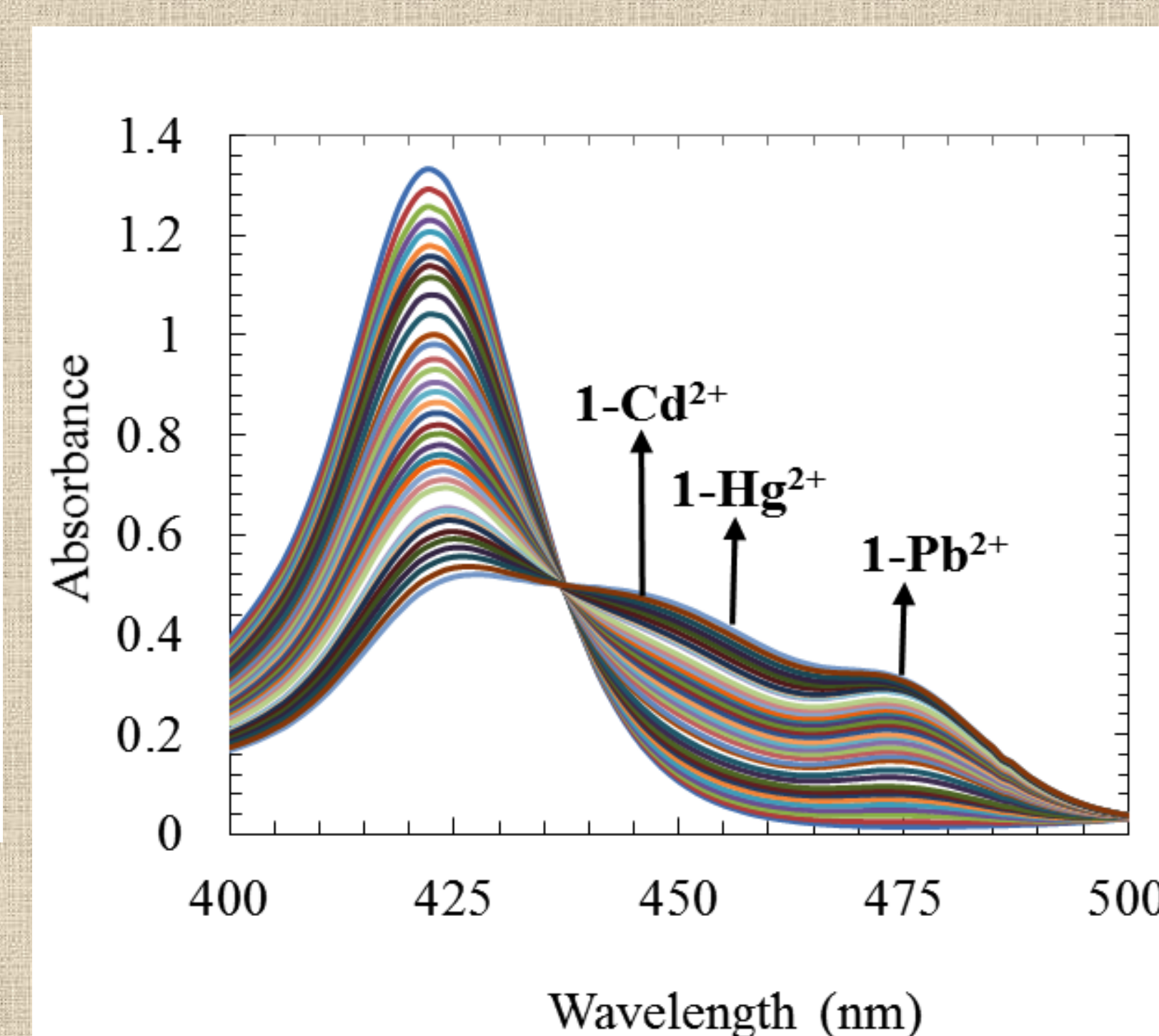
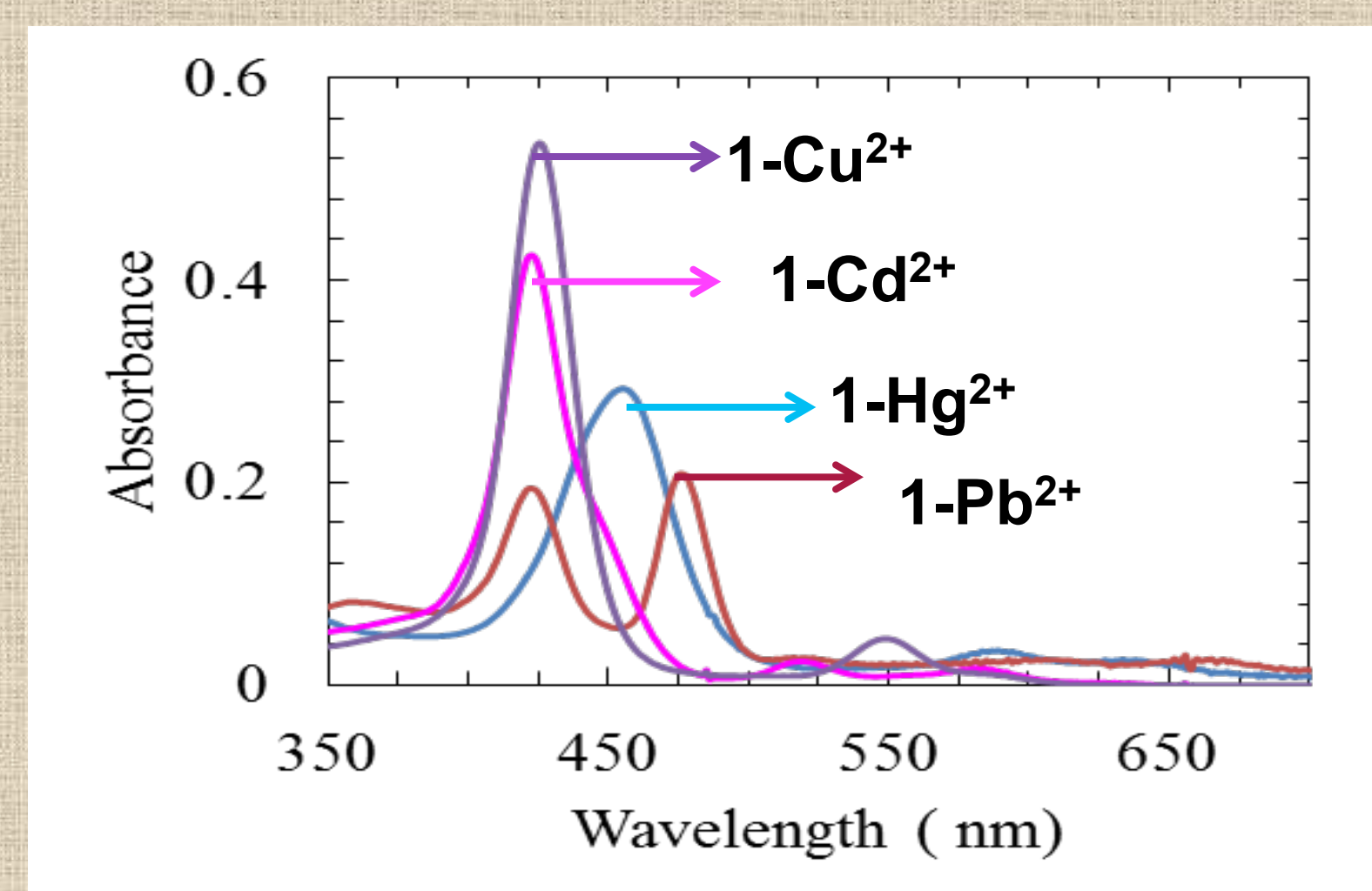
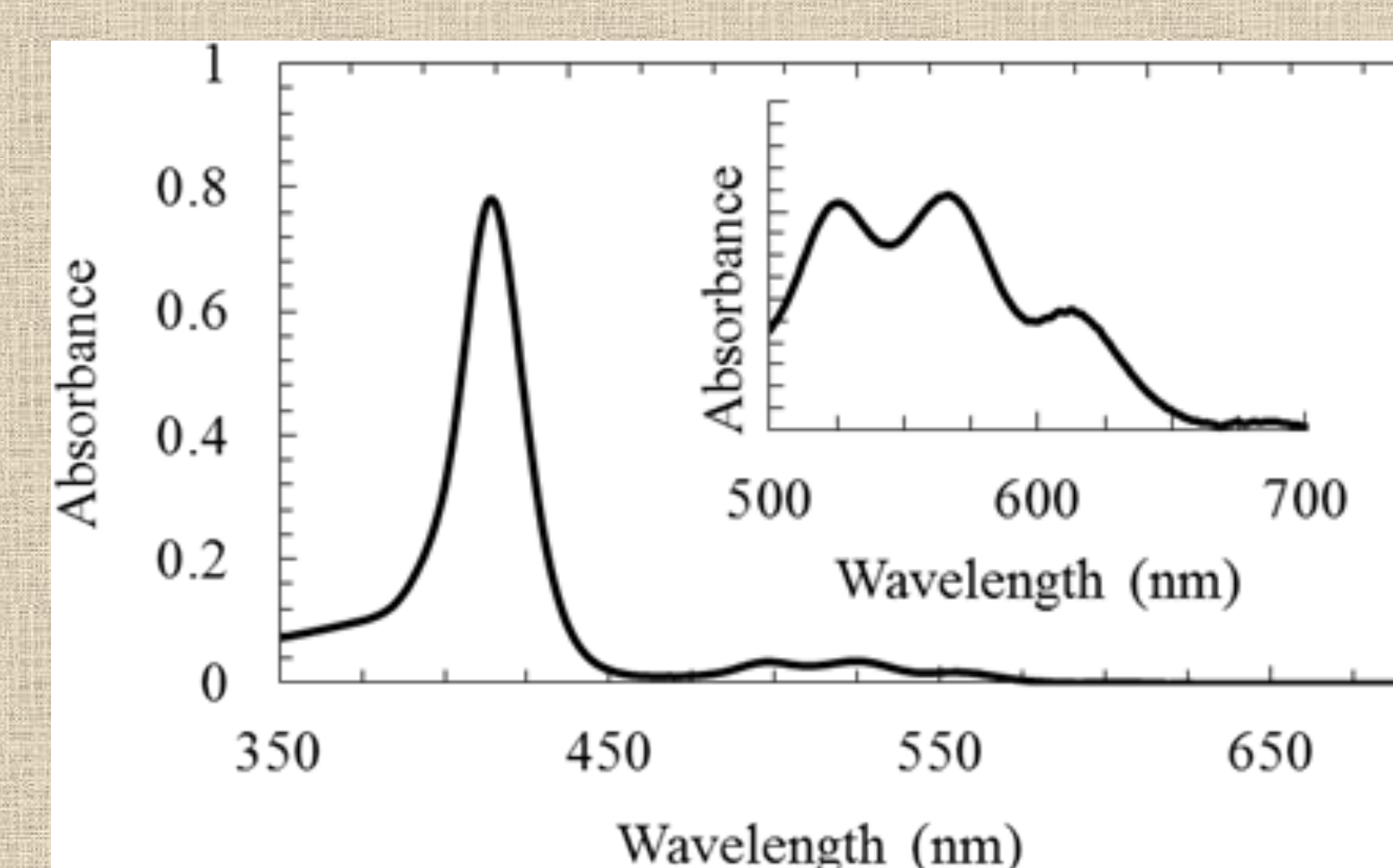
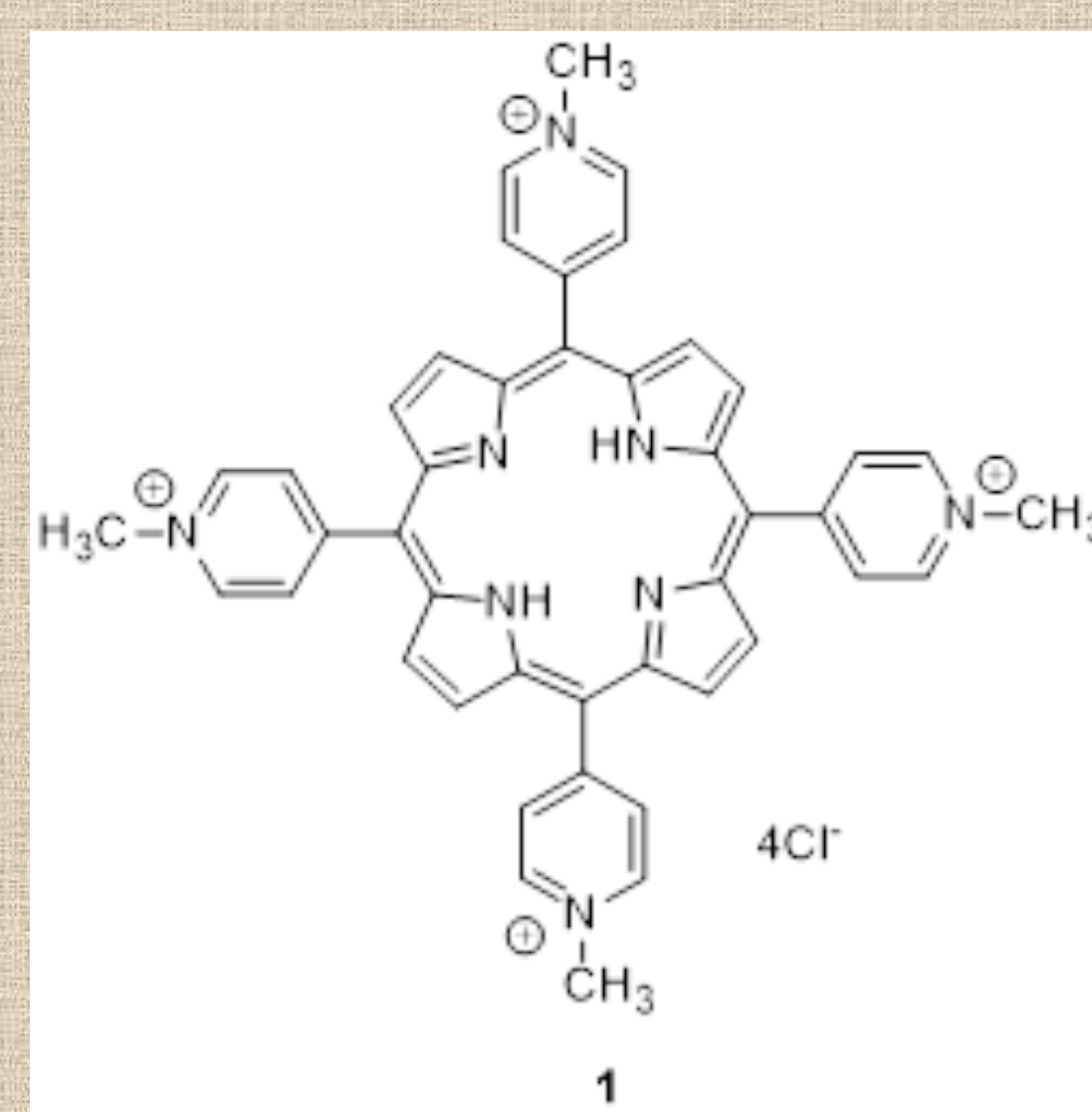
INTRODUCTION

- Toxic metal ions are dangerous to human health and environment.
- Determination of metal ions, particularly, Hg²⁺, Pb²⁺, Cd²⁺, and Cu²⁺ simultaneously by using an inexpensive, water soluble porphyrin based optical sensor has always been a great challenge.
- In addition, the preparation of porphyrin-based optical sensors often requires complex organic syntheses, which are very costly, and time consuming.
- Furthermore, the porphyrin-based sensors are water insoluble, which limits the detection of metal ions in aquatic environment.

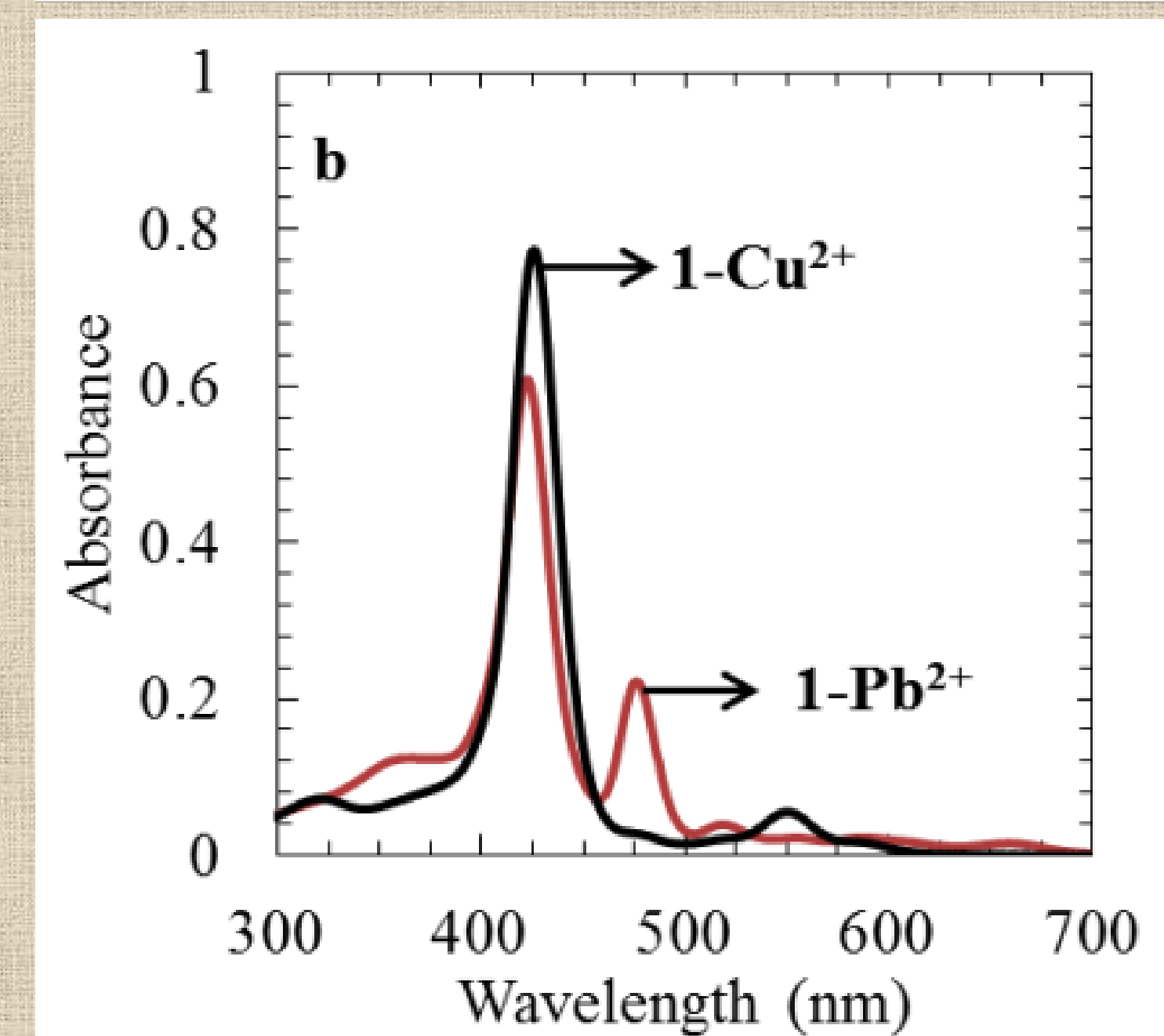
PURPOSE

- To find a simple, inexpensive, water soluble, and commercially available porphyrin
- a single optical chemical sensor capable of detecting any or all Hg²⁺, Pb²⁺, Cu²⁺, and Cd²⁺ ions simultaneously

RESULTS



Cd²⁺ ions are detected in the presence of larger metal ions such as Pb²⁺



Cu²⁺ ions are detected via metal displacement from the 1-Pb²⁺.

FUTURE PLAN

- Preparation of solid sensor **1**
- Determination of toxic metal ions in aqueous solution using solid sensor **1**

CONCLUSIONS

- We found water soluble, inexpensive, and commercially available cationic porphyrin **1** produced different electronic absorptions in UV-vis region upon interacting with Hg²⁺, Pb²⁺, Cd²⁺, and Cu²⁺ ions.
- The porphyrin **1** showed the ability to detect multiple metal ions, particularly Hg²⁺, Pb²⁺, and Cd²⁺ in aqueous solution.
- The porphyrin **1** displayed the ability to determine Cd²⁺ ions more easily when other metal ions with larger ionic radii are present.
- The porphyrin **1** detected Cu²⁺ via metal displacement from the **1**-Hg²⁺, **1**-Pb²⁺, and **1**-Cd²⁺.

ACKNOWLEDGEMENTS

- Michael A. Janusa, Chair and Professor of Chemistry and Biochemistry at SFASU
- The Welch Foundation Departmental Grant (AN-0008)
- RCA grant at the Stephen F. Austin State University Research Enhancement Program