

## **SOAR Research – Faculty Proposal – Summer, 2015**

### **Development of New Methods for Efficient Platinum Complex Syntheses**

**Faculty:** Stephen Dunham, Ph.D., Associate Professor of Chemistry

**Student:** Tony Rivera

#### **Recommendation Letter for the Program:**

I am recommending Tony Rivera as a SOAR summer research student because of his growth and commitment to research that I have observed as his mentor during his independent study in the Spring of 2015.

Tony Rivera has been completing an independent study working in my research laboratory during the Spring semester of 2015. In his independent study, Tony has been absolutely meticulous in his work and dedication to the research project. His notebook and attention to detail when performing experiments and using instrumentation have shown me that he is creative, intelligent, and committed to the process of learning through discovery in the lab. I have great confidence that not only will he be successful in the laboratory during this summer SOAR project, but that a summer research experience will further develop Tony's confidence in himself to be a successful student at Moravian and inspire him to strive toward a career in a scientific field.

Tony also has unique life experiences that I believe are worth noting when considering his QPA at Moravian. As a young single father, actively involved in his daughter's life, he has at times struggled with balancing the time commitment required to maintain custody and take care of his daughter and meet the demands of a full class schedule each semester. Also, as a veteran, my understanding is that Tony is required to have a specific number of credits per semester to maintain his VA funding. I also understand that he might lose his funding from the VA if he were to withdraw from a course and not be a full time student. So the end result is that Tony has accepted three failing grades in courses that other students in his situation would have likely withdrawn. He has already repeated one of the failed courses, Organic Chemistry, and earned a B+ in that course.

I am confident that Tony will succeed on this project and that success will support him to continue his studies at Moravian and pursue a scientific career.

Sincerely,



Stephen U. Dunham  
Associate Professor of Chemistry

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### Development of New Methods for Efficient Platinum Complex Syntheses

**Faculty:** Stephen Dunham, Ph.D., Associate Professor of Chemistry

**Student:** Tony Rivera

**Project Start Date:** June 1, 2015

**Length of Project:** 10 weeks

#### **Description of the project**

##### *Development of New Methods for Efficient Platinum Complex Syntheses*

We are particularly interested in the study of transition metal compounds that have anticancer properties. Cisplatin is one such transition metal complex that has been used to treat specific types of cancer for nearly 40 years. The synthesis of highly pure cisplatin and other platinum complexes remains a challenge to chemists seeking to carry out reactions that are specific and efficient. Often in the discovery of new compounds, research is focused on identifying the structure and properties of the new complex with little concern about the efficiency and cost of the synthetic method. We are interested in developing new methods that allow for multistep reactions to occur in a single reaction vessel to lower costs and increase efficiency. This “one pot” approach has not generally been used for synthesis of platinum complexes. Rather, complexes are often obtained by running up to four different separate reaction steps and the product is isolated at the end of each reaction step. This step wise process is not only time consuming, it has a lower atom efficiency, and typically produces more waste and higher costs.

##### *Synthesis and Isolation of Known Platinum Complexes*

The first goal of the project is to synthesize known platinum complexes similar to cisplatin using a “one-pot” approach. This work will build off the success of Tony Rivera’s independent study project in the Spring of 2015. By varying solvent conditions and starting materials, we have obtained preliminary data that support the synthesis of a known platinum compounds in a single reaction container without isolation of intermediates. We will continue to explore the selectivity and efficiency of “one-pot” methods by attempting to synthesize ~10 known platinum complexes using this method. By trying to make several known compounds, we will have a better understanding of how general the method is for platinum compound synthesis.

##### *Synthesis of New Platinum Complexes*

A second goal for the project will be to develop one or more new “one-pot” methods to prepare new platinum complexes. By making compounds that have not been prepared before, we will hopefully be able to demonstrate that this methodology is even more widely applicable to platinum compound synthesis. New complexes will be isolated and

characterized by nuclear magnetic resonance (NMR) and MALDI mass spectroscopies to confirm their unique structures.

### **Roles and responsibilities**

- As project director, Stephen Dunham will be available to train Tony on the use of instrumentation, platinum compound synthesis reactions, data analysis, and generating visual representations of experimental results.
- Tony will prepare and present his findings at daily meetings (~15-30 min).
- Tony will maintain a research laboratory notebook that will include regular and complete entries. The laboratory notebook will have an updated table of contents at the beginning. Entries should be dated, clearly written and organized, and made at least daily with details of ideas for experiments, planning of experiments, clear reference to location and organization of electronic data for each experiment, and a summary of results from each experiment. Stephen Dunham will look at Tony's notebook periodically and provide informal feedback throughout the summer. The notebook will be submitted to Prof. Dunham upon completion of the Summer Research.
- Throughout the summer, Tony will prepare summary figures for each set of experiments (with detailed figure caption!) to clearly illustrate the results of each experiment. These summary figures will be submitted electronically before completion of the Summer Research.
- Tony may consider continuing this research as an independent study during the 2015-2016 academic year, so a final report/poster may not be required at the end of the summer but instead by the end of his research experience and in time for the Annual Student Scholarship and Creative Endeavors Day in spring of 2016.

### **Project Timetable**

- Weeks 1-5: Carry out one-pot synthesis reactions on ~10 known platinum complexes. Learn to operate various instruments: HPLC for reaction monitoring and complex isolation, NMR, and MALDI-MS for platinum compound characterization.
- Weeks 6-10: Carry out one-pot reactions to prepare new platinum complexes. Isolate and characterize new complexes.

### **Summary of benefits**

*Student engagement in discipline-appropriate scholarly research.* Tony will be engaged in synthetic inorganic laboratory research that includes reading and summarizing primary literature, planning and performing experiments that require the use of several new instrumental methods, and collecting/analyzing/organizing significant amounts of electronic data. In addition, he will prepare and receive feedback on various visual representations of experimental results (preparing figures in a format appropriate for publication in a Chemistry journal). Prof. Dunham will work with Tony to prepare a scientific poster for presentation of this work for the Annual Student Scholarship and Creative Endeavors Day, and possibly another presentation at a local or national research conference.

*Impact on faculty, campus community, and discipline.* Tony's work on this project will contribute to the discipline of inorganic chemistry by developing new methods for the synthesis of important platinum compounds. This project will benefit the Prof. Dunham by providing data for a future publication of this method in a peer reviewed Chemistry journal. By presenting his research during the summer to the SOAR group, and as a poster at Moravian Scholarship and Performance Day in April 2016, Tony's work will impact the campus community at Moravian by exposing others to interesting and complex nature inorganic chemistry research.

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- The body of the proposal should contain an itemized list of equipment, supplies and/or travel expenses for the project. For each item, describe why it is necessary for the successful completion of the summer project, and if relevant, how the item supports a long-term project.
- Explain why each requested material item is not available through existing on-campus resources (e.g. CIT or Inter-library loan) or why the available item is insufficient for the project. Note that SOAR has a standing agreement with CIT to make laptops available for the 10 weeks of the summer program.

#### Budget Items

- \$500.00 to offset part of the costs for reagents required for synthesis and characterization of platinum complexes.
  - Cisplatin \$ 420
  - Potassium tetrachloroplatinate \$ 200
  - Total \$ 620**
- Remaining equipment and reagent expenses will be covered by the Department of Chemistry.

Cisplatin is used as a starting material required for the synthesis of platinum complexes. It is a consumable specialized reagent so there are no standard supplies of this compound available at Moravian.

Potassium tetrachloroplatinate is a commercial starting material required for the synthesis of platinum complexes. It is a consumable specialized reagent so there are no standard supplies of this compound available at Moravian.