

# UNIVERSITY OF LOUISIANA AT LAFAYETTE

STEP Committee

Technology Fee Application

**Combined Electrosynthesis and  
Electroanalysis for Chemistry  
Laboratory Courses**

---

Title

**Yu Wang, Hui Yan, Ryan Simon**

---

Name of Submitter  
*(Faculty or Staff Only)*

**Department of Chemistry**

---

Organization

Title: Combined Electrosynthesis and Electroanalysis for      Date: 7/15/2018  
Chemistry Laboratory Courses

---

Name (Contact Person): Yu Wang

---

Address: P.O. Box 44370, Lafayette LA 70504

---

Phone Number: (337) 482-5682      Email: yuwang@louisiana.edu

---

Department/College/Org: Chemistry

---

**ABSTRACT (250 words or less):**

This is a request to purchase two IKA Electrochemistry Kit ElectraSyn 2.0 pro Packages with necessary accessories for chemistry labs, at a cost of \$5788.00. ElectraSyn 2.0 is a simple device combines electrochemical analysis and electrochemical synthesis in one. With the relatively low price, very simple setup and easy operation, this device helps to improve the efficiency of in-class illustration compared to conventional electrochemistry stations and allows more students to have access to perform electrochemistry experiments. One advanced polymer synthesis method, namely electrochemically mediated atom transfer radical polymerization (*e*ATRP), will be integrated into the Maker Laboratory which was established in 2017 through the STEP grant for students to experience polymer synthesis and processing techniques. Typically, *e*ATRP requires very complicated setup; however, with ElectraSyn 2.0, the setup can be significantly simplified. All chemistry major students and many other students with a science or engineering major will have the opportunity to learn and practice this technique. The required devices will also be used in CHEM 221-Analytical Chemistry and CHEM 430 G - Instrumental Analysis, as well as in CHEM 362-Undergraduate Research I. It is estimated that > 100 students/yr will enhance their knowledge in electrochemistry through the technology in ElectraSyn 2.0, both directly and indirectly.

## A. Purpose of Grant and Impact to Student Body as a Whole

This application is to request funding for the purchase of the electrochemistry equipment needed for polymer chemistry related experiments and for analytical chemistry classes.

Electrochemistry is an important technology in both analytical chemistry and synthetic chemistry. Typically, an electrochemistry station is required to perform electrochemical experiments. Conventional electrochemistry stations are usually expensive, i.e. > \$ 10000, and difficult to setup and to operate. IKA ElectraSyn 2.0 is a simple device combines electrochemical analysis and electrochemical synthesis in one. The device can be used to determine the redox potential of a chemical species in solution by cyclic voltammetry method; or as a potentiostat to carry out an electrochemically driven reaction. The design includes glass vials with different volumes as the container and electrodes integrated into one place as the cap of the glass vial. The assembly of the electrical cell is very simple, which makes it very easy to use. The price of ElectraSyn 2.0 is also much lower than conventional electrochemistry stations. Though it does not offer some advanced functions, as other electrochemistry stations would do, the functions of ElectraSyn 2.0 is sufficient for teaching purposes and for simple electrochemical synthesis. Because of the relatively low price and easy operation, the in-class illustrations will become much more efficient. Meanwhile, more students will have opportunities to perform electrochemistry experiments because of the availability of more devices and less occupation time for each experiment. If the funds are approved, one of the requested ElectraSyn 2.0 will be placed in Montgomery Hall 120B; the other one will be placed in Montgomery Hall 206 the analytical chemistry lab.

Dr. Yu Wang teaches General Chemistry courses and laboratory, CHEM 303 Introductory Physical Chemistry, CHEM 311 Physical Chemistry Lab I, CHEM 362-Undergraduate Research I, and CHEM 490 Directed Individual Study. A new polymer chemistry course, i.e. CHEM320 Chemistry of Macromolecules (~ 80 students/yr), will be offered from spring 2019. All chemistry major students are required to take this course. Students with other science or engineering majors are also encouraged to participate. Dr. Ryan Simon teaches General Chemistry courses and laboratory, Organic Chemistry courses and laboratory, and CHEM 362-Undergraduate Research I. Together with Dr. Yu Wang, he established a Maker Laboratory equipped with a LulzBot TAZ 6 3D Printer at Montgomery Hall for students to experience polymer processing techniques through the support of STEP grant in spring 2017. With the requested ElectraSyn 2.0, a most advanced polymerization technology, namely Electrochemically Mediated Atom Transfer Radical Polymerization (eATRP), will be integrated into the Maker Laboratory. This advance polymerization method, eATRP, can produce polymers with regular molecular sizes compared to polymers with irregular molecular sizes produced by conventional methods. However, typical setup of eATRP is very complicated and is difficult for undergraduate lab courses. With the required equipment ElectraSyn 2.0, the setup of eATRP can be simplified significantly, thus students will have the opportunity to practice this up-to-date technology. More information about eATRP could be found in the following references.

1) Andrew J. D. Magenau, et. al., Electrochemically Mediated Atom Transfer Radical Polymerization, *Science* **2011**, 332, 81–84.

2) P. Chmielarz, et. al., Electrochemically Mediated Atom Transfer Radical Polymerization (eATRP), *Progress in Polymer Science* **2017**, 69, 47–78.

Dr. Yu Wang has a research lab at Montgomery Hall 120A (the south half of the room) which provides enough space for students to perform polymer synthesis experiments including but not limited to eATRP mentioned above. The LulzBot TAZ 6 3D Printer is located in the same room, Montgomery

Hall 120B (the north half of the room). Altogether, the Maker Laboratory will provide students with a space to practice polymer synthesis and processing techniques.

Dr. Hui Yan teaches General Chemistry courses and Laboratory, and analytical chemistry related courses CHEM 221-Analytical Chemistry, CHEM 222- Analytical Chemistry Laboratory, CHEM 270-Chemical Literature, CHEM 362-Undergraduate Research I, CHEM 430 G - Instrumental Analysis. The acquisition of ElectraSyn 2.0 will be implemented in two specific courses: CHEM 221 and CHEM 430. In CHEM 221(~90 students/yr), the concept of cyclic voltammetry will be introduced and the results generated from the ElectraSyn 2.0 will be shown to students, to illustrate key concepts in electrochemistry. In advanced course CHEM 430 (6-9 students), one lab experiment has been designed to use cyclic voltammetry to perform electrochemical analysis of acetaminophen in a common pain relief medication, the acquisition of ElectraSyn 2.0 will provide an opportunity for faster experimental setup and allow students to do more tests in one class. Cross-analysis of results generated from the current method and from ElectraSyn 2.0 will also help the students to understand the technique better.

Therefore, it is estimated that > 100 students/yr will enhance their knowledge in electrochemistry through the technology in ElectraSyn 2.0, both directly and indirectly. The instructors and professors who oversee the laboratory will maintain the equipment and ensure that work for all students for many years to come.

## **B. Projected Lifetime of Enhancement**

The projected lifetime of the instruments requested is over ten years.

## **C. Person(s) Responsible for:**

**Implementation:** Yu Wang, Hui Yan, Ryan Simon

**Installation:** No installation needed

**Maintenance:** Routine maintenance covered by the Department of Chemistry

**Operation:** Faculty of the Department of Chemistry, Chemistry Students and the Students from other departments who choose relevant courses in chemistry

**Training:** Faculty of the Department of Chemistry

## Budget Proposal

---

**1. Equipment                    \$ 3998.00**

The list price of one IKA Electrochemistry Kit ElectraSyn 2.0 pro Package is \$ 1999.00 ([www.ika.com](http://www.ika.com)). Two are requested.

**2. Software                    \$ 0**

No software is needed.

**3. Supplies                    \$ 1690.00**

The list price of one ElectraSyn Electrode Starter Kit is \$ 992.00 ([www.ika.com](http://www.ika.com)). The list price of one ElectraSyn Complete Vial Kit is \$ 698.00 ([www.ika.com](http://www.ika.com)). The total price of supplies is \$ 1690.00.

**4. Maintenance              \$ 0**

Routine maintenance will be covered by the Department of Chemistry.

**5. Personnel                   \$ 0**

No additional personnel required.

**6. Other                        \$ 100.00**

Shipping.

---

**TOTAL:                        \$ 5788.00**

## **Other Relevant Information**

None.

## **Previous STEP Projects**

Hui Yan and Febee Louka “Bring Rotary Evaporator for Sample Preparation to Analytical Chemistry Laboratory Courses”, Fall 2017

Hui Yan and Febee Louka “Improving Precision and Accuracy in Analytical Chemistry Laboratory Courses”, Fall 2016

Ryan Simon “Whiteboards for Montgomery Hall”, Fall 2017

Ryan Simon and Yu Wang “Maker Laboratory for Montgomery Hall”, Spring 2017

Ryan Simon “Chemistry Laboratory and Demonstration Equipment Grant Proposal”, Fall 2016

Ryan Simon “Organic Chemistry Laboratory Equipment”, Spring 2016