

Andrew Baublis

**Graduation Year:** Sophomore

**College:** Science

**Major(s):** Chemistry, Math

**Minors(s):** Glynn

**Scholar Group Membership:** Glynn

**Did you received other funding for this project?:** CoS

**Could you have completed this project without CUSE funding?** No

**More details on CUSE funding assistance?**

**Project Title:** Cesium Lead Halide nanocrystal synthesis

**Project Location:** University of Notre Dame

**ND Faculty Mentor:** Dr. Kuno

**Project Type:** Research

**Why did you undertake this project/experience?** Deepen your knowledge of a topic or issue, Research/experience necessary for senior thesis or capstone project, Prepare for graduate school (MA or PhD)

**Did your funded experience help you:**

**[Deepen your understanding of your coursework or field of study]:** Very Much

**[Discern your interests and post-bac goals]:** Very Much

**[Become confident in your ability to set and achieve your goals]:** Very Much

**[Gain a more nuanced view of local, national, or global communities]:** Yes

**[Improve your written and verbal communications skills]:** A Little

**Tell us about your experience.**

This summer I continued working in the lab of Professor Kuno, which I joined this past semester. Dr. Kuno's lab focuses on chemical nanowires and optics. This summer I worked on two projects, one that was a continuation of my previous work from the past semester and the next a new project. The projects were done in conjunction with Graduate Students Mike Brennan and Jessica Zinna who helped guide and teach me throughout the summer. The continued project was an attempted synthesis of Methyl Ammonium Lead Iodide (MAPbI) nanowires based on a procedure shared by another research group. The new project I worked on was the synthesis of various sized samples of Cesium Lead Halide (CsPbX) nanocrystals. Along with the bench work of inorganic synthesis I worked on literature research and data collection with guidance from Mike and Jessica.

The attempted synthesis of the MAPbI nanowires was the project worked on with Mike this previous semester. The project was based off of a procedure shared with Mike from other researchers at IUPUI. The foremost goal of the project was successful synthesis of the wires through a method similar to the one used by the researchers at IUPUI. This was to confirm that the synthesis of the nanowires was reproducible in another laboratory setting. After six months

of work attempting to synthesize the wires through methods similar to the IUPUI researchers it was concluded that the method was not reproducible. The follow up conclusion was that time could be better spent on a more fruitful project.

The synthesis of CsPbX nanocrystals was a project worked on with both Mike and Jessica throughout the entire summer. The overarching idea of the project is to investigate a possible size dependent relationship of the nanocrystal's Stokes Shift, a gap between the particles absorption and emission peaks. This required careful synthesis of the nanocrystals in attempts to create samples with close size distributions, but a wide range of sizes between samples. This required many synthesis trials attempting to fine tune the procedure and after the procedure was determined required many samples to be made for enough proper data points to investigate a possible relation. To measure the crystal sizes it was necessary to use a TEM to view the crystals and then physically measure the images on a computer. Furthermore, to investigate the Stokes shift of the nanocrystals absorption and emission spectra were necessary so characterization through UV visible spectroscopy and a fluorometer. At the end of the summer Mike and Jessica began to compile their findings and past literature to write the paper for this project. I was able to help with simple literature and data compilation to assist them. So far it is clear that there is a size dependence regarding the Stokes shift, and now it must be investigated as to how this arises in the crystals. Another member of Dr. Kuno's lab, Sergei, also required CsPbX nanocrystals for his experiments in the optics lab. These crystals were of a mixed halide variety, containing different ratios of Bromide and Iodide. I was able to help him by synthesizing these crystals for him on multiple occasions.

**Describe the impact this project had, both on you as a student-scholar and on the people you worked with.**

This summer has been a wonderful experience for me as I learned about the field of research. Learning how to do inorganic synthesis was exciting and new. I also learned how to do day to day research and learned about approaching experiments with the scientific method in real-time adjusting variables properly in order to still come up with conclusions that gave useful information. I also learned a lot about scientific literature this summer, as I had to do quite a bit of reading in order to keep my head above water in regards to the "how" of the work I was doing. The exposure to literature gave me a feel for the way that research works in a way I'd never considered before, as publishing is the goal of most projects. Seeing how literature can be used as both inspiration and a measure to hold oneself to was educational. This summer gave me an introduction to research in a way that I would never have gotten from working in the lab during the semester balancing classes. I was able to achieve true results by working with Mike and Jessica. I also feel as if my presence in the lab as an undergrad brought about a new experience for Mike and Jess as they had to take on teaching roles at times to help me learn how to operate in lab. and subsequently completing syntheses on my own was a real accomplishment for me as I became comfortable working in lab independently. I hope to continue this newfound comfort in the lab this coming semester as the nanocrystal project wraps up and hope to start my own project.

**Describe how this experience is connected to your plans as a student or future professional.**

I was able to spend this summer being introduced and working on chemistry that I would not have seen until graduate studies otherwise. I've become fascinated by the world of nanomaterials and physical chemistry and hope to continue working and learning about it. As an undergraduate, starting research early can be essential to finding ones proper place and field, this summer has helped me not only explore the possibilities involved in research but how it is properly conducted as well. Knowing how to think and work in a lab setting is an invaluable skill that, provided I continue on my chosen career path, will use for the rest of my academic and professional careers. I hope to continue with my undergraduate research at Notre Dame and move on to further my chemistry education and research by pursuing a PhD. This summer I was able to experience how research is a collective endeavor, where scientists each contribute in small parts for a greater whole looking for better understanding and practical use of the world around us. I hope to one day be part of this collective endeavor, and this summer was able to first dip my toes into it.

**What advice would you give other students who are planning to pursue similar projects?**

If another student were to pursue a similar project to me, I would advise them to have patience. It can be hard to join a full time research environment for the first time especially being as unexperienced as I was. there will be a period where you're not quite as useful as you'd like to be, but it will pass and you'll be able to work on what you came to accomplish. Furthermore don't be discourage by a lack of success, thats just how science works sometimes. What's important is learning how to approach a lack of success and how to better approach it the next time for more satisfactory results.

I acknowledge that this form has been filled out truthfully and to the best of my ability. I understand that this information will be shared with many different CUSE constituencies. As such, I have provided as much useful information as I was able. I understand that CUSE will not complete my award disbursement until this form is successfully completed. If I have any questions or concerns, I will contact CUSE before submitting this form. To illustrate that you understand all of these points, please enter your Notre Dame email in the box below.

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