Quantum Dot Synthesis
UConn IMS 2015

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Summer Internship / Pettes Institute of Materials Science Lab

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Who We Are

• Rising seniors in high school

• Work together in school on numerous things; Robotics president and captain respectively, National Honor Society co-presidents

• Focused on physics and math; took AP Calculus BC, AP Physics C: Classical Mechanics last year, will take Multivariable Calculus and AP Physics C: Electricity and Magnetism next year

• This summer, we are working in Dr. Pettes’s lab, shadowing Sajad Yazdani, and collaborating with Katherine Nuzzo and Ruth Thomas
Our Investigation

• Quantum dots are nanocrystals with an array of useful properties
• The most visibly interesting aspect of these crystals is their fluorescence
• Under ultraviolet light, Cadmium-based quantum dots exhibit bright, visible fluorescence
• We will be focusing on CdS and CdSe compositions

  http://dx.doi.org/10.1021/ed300568e
  http://dx.doi.org/10.1021/ed082p1697
Objective

• This summer, we wanted to learn more about research and conduct some of our own

• We were presented with the great opportunity to experience graduate level research first-hand

• Sajad suggested research in Cadmium-based quantum dots because of their rewarding visual component

• We would like to continue research in Dr. Pettes’s lab this school year
The Process

• Six weeks ago, we were completely new to the concept of quantum dots, so we have spent a lot of time doing research in the library on the mechanisms behind the properties we will observe

• By reading multiple studies, we were able to put together several possible procedures to synthesize our first batch of quantum dots

• Katherine and Ruth, as high school teachers, are helping us to understand what safety restrictions we need to take into consideration

• After successfully synthesizing our first batch of quantum dots, we will attempt to alter our procedures to make them more high school friendly
Lab Work

• Under Sajad’s supervision, we were able to conduct experiments and operate equipment that allowed us to analyze the samples we created.

• We made three separate attempts at synthesizing quantum dots, two of which incorporated chemicals that deviated from proven recipes.

• Our third and final synthesis utilized all of the correct chemicals and was successful on the first try.
Learning

• In addition to our studies, Sajad and Dr. Pettes gave us tours of various labs to show us the research opportunities that are possible and the equipment that is available.

• We shadowed Sajad in several of UConn’s labs while he conducted some of his own research so that we could learn about some of the equipment that we may use in our research.
Results

• The experiment yielded 13 samples, each approximately 1 mL; we took them at increasing time intervals over the course of 6 minutes.
• Samples taken early in the experiment should contain quantum dots with a smaller radius and therefore an emission with a shorter wavelength.
• Our samples cover only the middle section of the spectrum.
• If we were to repeat the experiment, we would take samples both earlier and later in the experiment to obtain samples with wavelengths on both the red and blue ends of the spectrum.
Analysis

• We conducted analysis of our samples in the fluorescence lab
• After sitting for a week, the samples had deteriorated somewhat
• Due to ineffective methods of quenching the reaction, the peaks are broad
• However, they still show a definite trend towards higher wavelengths as a function of time, as we expected
Social Media

• We created a Facebook page to track our progress, complete with pictures and videos from our experience

• Katherine and Ruth are adding sections with resources for students and teachers who want to learn more about our research

• Relive our adventures at www.facebook.com/nanotech2015
Conclusions

• This process taught us a lot about what it takes to do research, including the extensive studying of others’ work that is a necessary prerequisite to lab experimentation
• We have both become more interested in research

Acknowledgments

• We have been working on our projects with Sajad Yazdani separately from his own research, so we would like to thank him for his time
• We have done all of our lab work in Dr. Pettes’s labs with help from him and his students