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Characterizing Solutions and Langmuir Films of Mixed-Color-Quantum Dots

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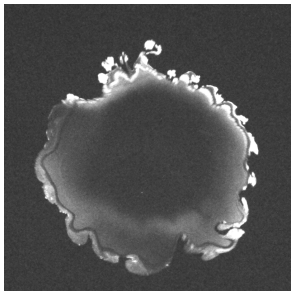
Project Description



Our goal is to produce well-ordered films of quantum dots (QDs) as Langmuir films. We image fluorescence from the floating films using a digital camera. A grayscale image of typical results is shown in the PDF document. We want to determine whether intensity differences in the images are due to multiple layers (layer-by-layer stacking) or tightly-packed layers (in-plane packing). Our hypothesis is that we can use multi-color QDs to distinguish between these two cases. You will prepare and measure the UV/VIS / fluorescence spectra of the mixed solutions to obtain relative concentrations. You will deposit the solutions as Langmuir films and image them with a digital camera. You will process the images and compare them quantitatively, for example as relative intensity maps. You will address whether your results validate or invalidate the hypothesis. A summary of other work on the project is found at posted on ResearchGate.

Duties, Contributions, and Outcomes

This RCEU program is designed for students who want to learn how to perform robust hands-on chemistry-type experiments, how to use UV/VIS and fluorescence spectroscopy, and how to analyze digital images.

The first objective in the first two to three weeks is to generate a written plan of attack. Your duties are to review relevant literature and to repeat previous base-line experiments in our group. Your final duty is to write a proposed plan that outlines such factors as the number of measurements you plan to make and the experimental protocols for each type of system (solutions and films). The second objective over approximately the next six to seven weeks is to perform, document, and report on measurements that you make. Your primary duties are to prepare solutions and measure their UV/VIS spectra, to prepare films and image them, and to analyze the spectra and images for quantitative information. The final objectives are to prepare a written report of your results and to complete the RCEU

Poster.

The primary contribution of your work is that you will validate or invalidate our working hypothesis. You will be encouraged to write your results as a publication for Perpetua. When the hypothesis can be validated, we plan to publish the work in a peer-reviewed journal.

You will learn how to use a UV/VIS / fluorescence spectrometer. You will learn how to analyze the spectra from the QDs in solution to obtain quantitative information about concentrations. You will learn how to produce Langmuir films of QDs and especially how to generate spontaneously self-assembled films. You will learn how to image the Langmuir films of QDs with a scientific-level digital camera. You will learn how to process the images for quantitative information such as relative intensity levels of the different colors.

Requirements and Mentorship

Requirements: You must have successfully completed CH 121 with the lab.

Preferences: Preference will be given to students who have taken both General Chemistry courses (and labs) as well as at least one additional junior-level chemistry, physics, or chemical engineering laboratory course that teaches quantitative analysis of experimental results. Preference will also be given to students who are willing to take a one-credit independent research course in Spring 2019 to establish the groundwork for the first objective. Taking this step will give a greater chance that your results are substantial enough to publish in an external peer-reviewed journal.

You will be supervised by me (Dr. J. J. Weimer) and a graduate student (Cuong Nguyen, MTS Ph.D.). In the first week, you will schedule time with me to collect literature and prepare protocols to share documents. You will also schedule time with the graduate student to learn how to prepare the solutions and films. In the second week, you will schedule time with me to learn how to use the UV/VIS / fluorescent spectrometers. In the third week, you will schedule time with me to learn how to image films with a digital camera. The hands-on efforts should involve about half of your time, with the other half for literature review and writing a project plan. Once you start your experiments, we will meet on a weekly basis on a fixed schedule (e.g. every Friday morning). You will present an oral report that outlines your progress, presents any issues, and proposes your plan of attack for the coming week.

The graduate student and I will be openly available at all times during the project to

address questions. We will correspond directly, via email, and using Skype or Zoom.