Elisabeth Kerns

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Department of Chemistry and Biochemistry

Kamat Laboratory

Slatt Fellowship Summer 2017 Research Summary

This past summer, I received the Vincent P. Slatt Fellowship for Undergraduate Research in Energy Systems and Processes. I worked under the direction of Professor Prashant Kamat in the Notre Dame Radiation Laboratory for ten weeks. While working, I received guidance and assistance from Rebecca Scheidt, a second-year graduate student in the Kamat Lab. The project from the summer has also continued into the current semester. Next semester, I will further continue with research based on my summer project. The basic scientific research focused the fundamental electronic properties of the materials that solar cells consist of. Greater understanding of the way electrons transfer within solar cells to generate current will improve the overall viability of solar energy.

The primary goal of my research was to determine the electron transfer processes in perovskite solar cells. Perovskite solar cells have emerged in recent years as a high-efficiency option for solar energy. These cells rely on assumed electron transfer from the perovskite, $CsPbBr_3$, to the conductive TiO_2. The electrons travel from higher energy in the $CsPbBr_3$ to lower energy in the TiO_2. This summer, I sought to confirm this charge transfer mechanism using absorbance spectroscopy.

The results of my research indicate that the predicted mechanism for electron transfer from $CsPbBr_3$ to TiO_2 in the presence of O_2 is correct, based on the spectroscopic experimental

results. Under direct irradiation in atmospheric conditions, the characteristic absorbance of $CsPbBr_3$ decreased when deposited on TiO_2. However, no such decrease in absorbance was observed when the $CsPbBr_3$ was anchored to ZrO_2 or under N_2 conditions upon direct irradiation. Thus, the decreased peak at about 525 nm for $CsPbBr_3/TiO_2$ in atmospheric conditions should be attributed to the transfer of electrons from $CsPbBr_3$ to TiO_2.

The research I completed last summer is directly relevant to current energy challenges. Improving the efficiency of solar technology in order that the energy source prove commercially viable remains an important challenge for science. The spectroscopic results of my experiments prove a charge transfer mechanism crucial to the working of perovskite solar cells. The basic materials characterization of the solar cell components from my experiment might be furthered into a deeper understanding of the electronic properties. I have continued a spin-off project this semester in which I have studied the properties of $CsPbBr_3$ on ZrO_2, and also by using emission and fluorescence spectroscopy. Next semester, I plan to continue the study of electron transfer in perovskite solar cells. This would not have been possible without the foundation developed under the Slatt Fellowship this summer. Other scientists in the field might use my work as a basis of knowledge about charge transfer in order to maximize the efficiency of solar cells.

I would like to thank the Christopher and Jeanine Slatt for awarding me the Vincent P. Slatt Fellowship for Undergraduate Research in Energy Systems and Processes. This fellowship gave me the opportunity to perform undergraduate research in energy and chemistry, and further my career and educational goals.