

2019 FaSTRAC Visit Summary, NSF's ChemMatCARS

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Focus: *Interaction of lipids with a newly synthesized prodrug for cancer treatment*

Goal: *A formulation and delivery strategy that will reduce side effects*

I had the honor of participating in the FaSTRAC program with my advisor, Dr. Ying Liu. We heard about the program through Dr. Binhua Lin during one of our beamtime visits to ChemMatCARS. It was a great learning experience for us to not only interact closely with the beamline scientists but also have a deeper understanding of our research and X-ray concepts.

My research project focuses on designing alternative prodrugs that are more effective than what is available on the market currently. (A prodrug is a compound that becomes a drug when it is metabolized in the body.) For example, we synthesized a new prodrug, and now we aim to prolong the circulation time, reduce cytotoxicity, and reduce dosing, which will reduce its side effects. We believe that nanoformulation will help us to achieve our goals. However, to produce effective nanoformulations, we need to first have a solid understanding of our system at a fundamental level. Techniques such as X-ray reflectivity and grazing incidence diffraction are extremely useful to study molecular interaction. Furthermore, the unique liquid surface setup at ChemMatCARS is designed to study amphiphilic molecules and their interaction at air-liquid interfaces. Our focus for the visit is to utilize the liquid surface setup to study the interaction of our prodrug and lipids.

My colleague, Paola Leon Plata (GSRC program) and I worked at NSF's ChemMatCARS at Argonne National Laboratory, for six weeks, from the end of May until early July. My advisor, Dr. Ying Liu, was also working with us for four weeks. We were given beamtime to do our experiments, and we had regular weekly meeting with Dr. Binhua Lin and Dr. Wei Bu, in which we discussed our results and future direction. As experts in the field, they gave us a unique perspective on our results that we usually would not think of as engineers.

Coming into the program, I expected to have a better understanding of my research project and X-ray physics, and what I achieved at the end of the training was more than what I hoped for, in both knowledge and experimental results. We worked mostly with Dr. Wei Bu, and despite his busy schedule, he always found time to answer our questions and gave us lectures about X-ray techniques and concepts every Monday. His continued dedication helped ensure our experiments ran smoothly. He came in to check on us regularly, even on weekends. Dr. Binhua Lin not only helped us arrange our lodging; she also gave us valuable suggestions and directions for our project. Dr. Mrinal Bera was very helpful in answering our questions as well. Lastly, during our training, we were encouraged to interact with other groups and learn about their experiments. Because of that, we had a chance to discover and learn about many different types of experiments that utilize the liquid surface setup. For example, we learned that some groups studied the mechanisms of protein and antibody adsorption to the lipid monolayer. Other groups studied drug-lipid interaction with surface X-ray techniques but also used fluorescence signals in addition to X-rays.

Overall, the training gave me a chance to experience interdisciplinary collaboration. It helped me expand my knowledge outside of my area of expertise, which, in turn, will open more doors for me in my professional career. I am grateful to have received this opportunity and I am excited to continue exploring and discovering new findings in my research project through the collaboration between our group and ChemMatCARS.