

Matthew Po

An interview with 2022 NNCI iREU participant, Matthew Po

Matthew, please tell us a bit about yourself.

I am currently a first-year PhD student at the University of California, Berkeley, studying chemical engineering. When I participated in the program I had just graduated from the University of Florida where I studied chemical engineering and economics. My hobbies include playing the piano, traveling/sightseeing/taking far too many photos of interesting things, and a bit of gaming.

My major research interests are nanomaterials and biotechnology. Before the program, I worked for three years with Carlos Rinaldi-Ramos lab at the University of Florida focusing on biomedical applications of magnetic nanoparticles, with a particular focus on magnetic particle imaging. I worked on a number of projects during my time in the lab, including developing computational tools for image analysis and characterization of imaging agents. The summer before the program, I participated in an REU at Georgia Tech with Kimberly Kurtis, where I studied the effects of cellulose nanofibers and nanocrystals on the hydration process in cement pastes.



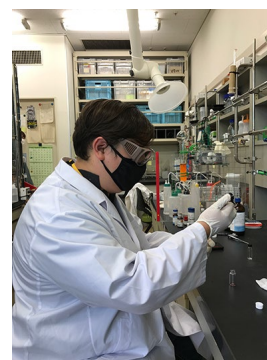
Thanks. Can you tell us a bit about your iREU research experience?

This past summer, I worked with Dr. Masayuki Takeuchi in the Molecular Design and Function Group at the National Institute of Materials Science (NIMS), with direct mentorship from Dr. Atsuro Takai. I also worked closely with PhD students in the group from various countries, including Japan, China, and the United States. I worked on this project for just over two months, starting on May 30 and concluding on August 5, 2022. My lab and office were located at the Sengen site of NIMS, only about a ten-minute walk from Ninomiya House (where I lived).

What did your research project entail?

Sensing the chirality of a molecule is a vital step before it can be used for its intended purpose, as two molecules that are equivalent in every way but in their chirality can have drastically different chemical properties (e.g. one can be a helpful drug and the other can be harmful). Current methods of sensing chirality in amines typically involve large, expensive instruments which take a long time to operate. My work focused on the use of supramolecular assemblies for cheap, rapid chiral amine sensing.

Over the course of my project, I synthesized a novel, supramolecular assembly-forming molecule, optimized conditions for its assembly, and characterized the resulting assemblies, particularly focusing on their structure and reactions with chiral amines. The fundamental idea behind this work was that, depending on the structure of a reactive supramolecular assembly, it is possible for it to demonstrate stereoselectivity in its reactions with different enantiomers of a given amine. In the beginning stages of my work, I focused primarily on synthesis of my compound. Of course, this involved techniques related to setting up reactions under controlled conditions, but a more significant portion of my time was dedicated to separations and purification of my target



compound. Separation techniques I used included rotary evaporation, filtration, column chromatography, and high-performance liquid chromatography. Verification of the compound's purity required nuclear magnetic resonance (NMR) and matrix-assisted laser desorption/ionization (MALDI) mass spectroscopy. Once I successfully obtained my target compound, I primarily used ultraviolet-visible (UV-vis) spectroscopy to characterize its assembly process and the reactivity of its supramolecular assemblies with amines of differing chirality. To understand the structure of the assemblies, I used atomic force microscopy (AFM).

My work resulted in the synthesis of a novel compound capable of producing supramolecular assemblies. Using UV-vis spectroscopy, I discovered conditions, particularly solvent conditions, under which these supramolecular assemblies can be formed and was able to visually demonstrate formation of these assemblies using AFM. Additionally, I performed preliminary studies that showed there were differences in the kinetics of the reaction of these assemblies with amines depending on the amine's chirality. This project would benefit from future work focusing on optimization of conditions for improved sensing ability.

You lived in Tsukuba for 10 weeks. Can you tell us about the laboratory and your experience living in Tsukuba.

My lab was located at the Sengen site of NIMS, just down the road from Ninomiya House. I happened to be the only one in the group this year whose lab was in Sengen, and this led to me being the only one in the group who walked to work every day (the rest rode their bikes to the Namiki site, about a mile away). I felt quite comfortable in my lab and at NIMS in general – language was not an issue at all at NIMS, as all of the scientific and administrative staff there can speak English. The only time I had trouble communicating with someone at NIMS was on my second day, when one of the ladies working in the cafeteria told me to get a tray for my food and I didn't understand her until she pointed at the trays. In Tsukuba and Japan in general, there were times that I had trouble communicating with people, but it was typically resolved with hand motions or a translation app.

Going back to the topic of the cafeteria, I ate my lunch in the cafeteria every day. Despite some of my lab members claims that the cafeteria food isn't that great, I enjoyed it quite a bit. They also have self-serve drink machines in the cafeteria offering green tea, black tea, and water, each with a hot and cold option, meaning you can have up to six unique drink/temperature combinations each time you eat there! The best part was that, in my opinion, the food was quite cheap – about 4-6 USD for a meal. Generally, I found that food in Japan was fairly cheap overall, and many grocery stores sold ready-made meals that I could simply pick up for dinner. I personally did not cook once while I was in Japan, barring the occasional use of my microwave/grill for warming up said ready-made meals (though 7-Eleven offers to warm up the meals for you!) and one incident where I boiled water. There are also plenty of restaurants around Tsukuba and all around Japan serving great food for reasonable prices. Personal favorites around Tsukuba include a skewer place down the road from Ninomiya House (Torikichi), a ramen place across the street (Menya Takahashi), and a conveyor belt sushi place a little over a mile away (Hama Sushi).

I thought Ninomiya House was quite a nice place to stay in a good location. The biggest daily challenges I had during my stay were the weather (hot and often rainy) and the bugs (watch where you step...).

Please tell us about your weekend travel experiences.

I traveled somewhere nearly every weekend during my stay in Japan. Places I visited included Tōkyō (numerous times), Ōsaka, Kyōto, Nara, and Hiroshima. Of these places, I'd say Kyōto and Nara were my favorites, though I also thoroughly enjoyed a trip to a small town in Tōkyō called Okutama. The most impactful place I visited was Hiroshima. The most fun places I visited were Akihabara and Shinjuku (the former is also the most bizarre place I visited) in Tōkyō. I could write pages detailing my trips around Japan, but instead I will limit myself to one paragraph.

In Tōkyō, I did a plethora of different things, including exploring historic sites, gardens, commercial areas, etc., shopping, eating, karaoke, meeting owls at an owl café, wandering around an art museum, watching a baseball game, tasting quite a bit of sake at a sake brewery, whitewater rafting, and viewing the city from above at the Tōkyō Skytree. In Ōsaka, I went to Universal Studios (including Super Nintendo World), met whale sharks at the Ōsaka Aquarium, and explored the Ōsaka Castle. In Kyōto, I visited the Imperial Palace and numerous temples and shrines, attended a festival, explored a bamboo forest, and met some monkeys. In Nara, I met, fed, and pet some deer after visiting two temples, one of which contained a giant Buddha statue. In Hiroshima, I toured museums, Peace Park, the A-Bomb Dome, and other historic sites on one day and visited Miyajima, an island off the coast of Hiroshima where I saw the "floating" Torii gate, the following day.

You can get nearly anywhere in Japan via train. While my father was driving me home from the airport, I said to him, "From the time I left [Florida] to the time I returned, I've been in more planes than I have cars." The rail system is very well developed in Japan, basically eliminating the need for cars unless you are traveling to a very remote area. Additionally, there are bullet trains ("Shinkansen") that you can take from Tōkyō to distant cities like Kyōto, Ōsaka, and Hiroshima. The Shinkansen can be a bit expensive, so I took advantage of a special deal for foreigners to mitigate this cost a bit. Foreigners are eligible for a Japan Rail Pass, which allows the holder unlimited access to any train owned by Japan Rail Company (including the Shinkansen) during the time that the pass is valid. Of course, the pass itself is expensive, but with enough travel, it comes out to be cheaper than paying for each individual ticket. I got mine for three weeks and traveled to Ōsaka, Hiroshima, and Kyōto/Nara during those three weeks. It even covered the ferry from Hiroshima to Miyajima! I loved that pass, and the day it expired was the saddest I felt during the entire summer.



What about COVID?

COVID was not an issue for me or anyone else in my group during our stay. Everyone in Japan still wears masks – I saw people walking alone outdoors still wearing masks – and

there are hand-sanitizing stations at the entrance to nearly every establishment you might enter.

Can you share any overall impressions of your experience?

Overall, I had a wonderful time in Japan. It was one of the most enjoyable summers I've ever had. The research experience was interesting and enriching, and it was an incredible experience to be able to explore the country and culture throughout the summer. I made lasting connections with the people I worked with at NIMS and intend to keep in touch with them. Additionally, I enjoyed getting to know my fellow interns as we navigated a foreign country together. If I was asked to participate in the program again, I would agree in a heartbeat.