

Report on MERIT Long-Term Overseas Dispatch

Department of Chemistry & Biotechnology, School of Engineering
Takashi Kato Laboratory, Takahiro Mikami (D3, MERIT Program 11th Cohort)

Place : David Kisailus Laboratory, University of California, Irvine

Period : July 10th, 2025 – October 10th, 2025

Research Project: : Analysis of the Crystal Growth Process of Organic/Inorganic Hybrid Colloids

Research Background and Contents: :

The process by which living organisms form skeletons and hard tissues is known as biomineralization. Biomineralization has attracted attention from both materials chemistry and biology because it enables the formation of sophisticated organic/inorganic hybrids under mild conditions. However, many aspects of its formation mechanism remain unclear. In Kato Laboratory, I have been working on the development of organic/inorganic hybrid colloidal liquid crystals inspired by biomineralization. Although I have synthesized several organic/inorganic hybrid colloids, the details of their crystallization process are not yet clear. Understanding these processes is important not only for understanding biomineralization but also for establishing synthetic strategies for organic/inorganic hybrid colloids. Therefore, I conducted research aiming to clarify these crystallization processes in the David Kisailus Laboratory, a leading expert in biomineralization and bio-inspired materials. Although the details cannot be disclosed because the results are unpublished, our analyses combining electron microscopy and electrochemical techniques revealed that the synthesis process of the organic/inorganic hybrid colloids was similar to the biomineralization in living organisms. I plan to do a more detailed analysis for the formation mechanism based on the findings.

Research Environment :

The University of California, Irvine (UCI) is a campus within the University of California system, located south of Los Angeles. The university hosts more than 30,000 students, including both undergraduate and graduate students. UCI comprises numerous schools, and Prof. Kisailus is affiliated with the Samueli School of Engineering. I conducted my research in the Engineering Tower, one of the main buildings of the School of Engineering. Irvine is a suburban city characterized by a safe and calm environment, and the campus itself is surrounded by abundant greenery. At the center of the campus lies a large, beautiful park called Aldrich Park.



Engineering Tower at UCI

The research environment was excellent. In addition to the lab's own equipment, researchers could easily access a wide range of shared instruments through an online reservation system. I made frequent use of the shared transmission electron microscope (TEM) facilities. Kisailus lab had weekly group meetings and regular coffee breaks. These casual gatherings, which is common in Western research culture, were new to me. These gatherings helped me connect with other lab members and feel part of the group very quickly.



Aldrich Park at UCI

Daily Life :

I was able to rent a furnished single-room apartment located on campus. Although the rent was quite high, I chose this accommodation for its excellent location and safety. The laboratory was only about a 10-minute walk away, which made commuting very convenient. Daily necessities were easy to obtain, as large supermarkets were within walking distance. Since eating out is considerably more expensive than in Japan, I cooked almost all of my meals myself. Although it was my first time living alone, the apartment was well equipped with kitchen facilities, allowing me to gradually become accustomed to cooking. On weekends, kind members of the research group often took me by car to lunch or to the beach. Some of them were interested in Japanese culture, and watching the Demon Slayer movie together in the United States remains one of my most memorable experiences.



Beach at Dana Point

Acknowledgements:

I would like to express my sincere gratitude to Prof. Takashi Kato for introducing me to Prof. David Kisailus and providing me with this invaluable opportunity to study abroad. I am also deeply grateful to Prof. Kisailus for warmly welcoming me into his group and for his kind and continuous guidance throughout my stay. I am also very grateful to Dr. H. Yu and all the Kisailus Lab members for their generous support. I would also like to thank Prof. Naoya Shibata, my co-supervisor in the MERIT program for encouraging me to pursue this opportunity. Finally, I am deeply grateful to the MERIT program for providing this precious opportunity, and to Japan Society for the Promotion of Science and Chihiro Kanagawa Foundation for Future Chemistry for their financial support.