変革を駆動する先端物理・数学プログラム (FoPM)

国外連携機関長期研修 報告書

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From the 3rd of June to the 24th of August, I stayed at the Lawrence Berkeley National Laboratory (LBNL) in Berkeley, California, USA, for discussion, technical training, and joint research on in-situ liquid-phase observation with a transmission electron microscope (TEM) in the group of Prof. Haimei Zheng. Prof. Haimei has been working on the development and application of the liquid-cell TEM technique as a pioneer in this field. Since my fourth year as an undergraduate, I have been working on the observation of crystallization and phase transitions in a vacuum using atomic-resolution TEM. During this research, I developed an interest in studying phase dynamics in solution environments, which is more relevant to practical applications, in particular the dynamics of solid-liquid interfaces. While reviewing related previous studies, I came across the research of Prof. Haimei. At the international conference on microscopy, IAMNano2023, held last year, I had the opportunity to meet Prof. Haimei during my poster presentation. I explained my research and expressed my interest in studying at her institution. After following up by email, I received a positive response, which led to the realization of this long-term research internship.

At LBNL, I engaged in the in-situ TEM observation and detailed analyses of crystal growth from aqueous solution under the guidance of Prof. Haimei and Dr. Qiubo, who is a postdoctoral fellow in the group. Although I cannot provide details of the research as it has not yet been published, it was confirmed that the observed crystal growth proceeded by a different mechanism than initially expected. This allowed us to gain some insight into the differences in interfacial behavior between vacuum and liquid environments. As of the writing of this report, we are planning further analysis and discussions to publish the results.

In addition to conducting the aforementioned research, building international networks was one of the key outcomes of this internship. During my stay in Berkeley, I had personal interactions beyond just lab work, such as dining with the lab members, chatting with students interested in Japanese subcultures like manga and anime, and attending a home party at Prof. Haimei's house. On the final day of my stay, we promised to keep in touch and meet again if we visit each other's countries in the future. I aspire to pursue an academic career after completing my PhD, and I found that more than half of them share the same goal. I sincerely hope that our paths will cross again somewhere in our research careers. Additionally, I had a chance encounter in downtown Berkeley with a senior from the Department of Chemistry at the University of Tokyo who is studying abroad in the Long group at UC Berkeley. This led me to connect with other Japanese graduate students and visiting researchers studying chemistry at UC Berkeley. Through these interactions, I gained insights into the differences between research environments in Japan and abroad, as well as the advantages and challenges of pursuing research internationally. These perspectives, which I



Fig. TEM in the LBNL

wouldn't have gained had I stayed in Japan, allowed me to reflect on my career from a broader viewpoint. This experience prompted me to seriously consider including overseas opportunities as part of my future career path.

Overall, this research visit was an exciting, valuable, and unforgettable experience for me. I would like to express my gratitude to my supervisor Prof. Eiichi Nakamura for forgiving me for being away from the lab for three months, my second supervisor Prof. Makiko Sasada in the FoPM program for giving me some advice from the mathematical point of view, Prof. Haimei Zheng for accepting my research visit, all the members in Haimei lab for helping with experiments and discussing results, and the financial support from the FoPM program for the research visit.