MERIT Long-Term Overseas Dispatch Program

Department of Chemistry and Biotechnology, School of Engineering
Sando Laboratory (M2)
Yohei Kondo

【Overview】

From September 3, 2018 to January 30, 2019, I stayed in Radiation Biology Branch (RBB), National Cancer Institute (NCI), National Institutes of Health (NIH) in Bethesda, Maryland. And I conducted research projects under the supervision of Dr. Murali Krishna Cherukuri. In this report, I will describe the background of this overseas dispatch, contents of the research, and the life in Bethesda.

【Background】

NIH is the nation's medical research agency in the United States and is an assembly of various specialized research institutes that conduct biomedical research on the cause, treatment and prevention of diseases. RBB where I stayed during this program belongs to NCI. Dr. Murali Krishna's group is developing and clinically applying oxygen-concentration and metabolism imaging technology to predict the diagnostic and therapeutic effects in the tumor.

Building 10 in the main campus of NIH

In Sando laboratory, I am developing highly sensitive nuclear magnetic resonance (NMR) molecular sensors to detect physiological parameters in living organisms such as mice. However, even around the world, there are not so many places where hyperpolarized-MRI experiments using disease models can be conducted. We were conducting collaborative research projects by sending samples to RBB. Then, in order to accelerate the project by immediate feedback of the result and to acquire expertise of hyperpolarization, I stayed in Dr. Murali Cherukuri's group to conduct the researches

【Research】

During my stay, I conducted application of highly sensitive NMR molecular sensors. Dynamic Nuclear Polarization (DNP), which can enhance the sensitivity of NMR several

thousand times by changing the nuclear spin state from the thermal equilibrium state to the hyperpolarized state, was applied to molecular sensors. The operation of nuclear polarizers was supported by Dr. Kazutoshi Yamamoto and Dr. Tomohiro Seki. Establishment of disease models and application was kindly supported by Dr. Tomohiro Seki.

The hyperpolarized state is realized by setting sample solution under a cryogenic temperature using a polarizer and irradiating microwave for several hours. Dissolution by highly heated buffer gives us hyperpolarized solution which can be directly injected into mice. According to this procedure, I tried real-time observation of various physiological parameters such as enzymatic activity. Although I have to skip the details of the result because we plan to submit papers, I obtained the hopeful result suggesting that it was possible to detect the enzymatic activity that is related to specific cancer. Moreover, I fed back the result of *in vivo* application to the molecular design and improved it by conducting organic synthesis.

Through this stay, I was able to realize how my molecular sensors are practically applied. Day-to-day experiments and discussions strengthened the connection with researchers in Dr. Murali Cherukuri's group. After I came back to Japan, I am continuing discussion and doing collaborative research projects.

【Life in Bethesda】

Bethesda belongs to State of Maryland and is located near Washington D.C. Due to its geographical nature, various government agencies including NIH exist nearby. Therefore, the public security in the neighborhood was good. Public transportation such as buses and metro were really developed and I was able to live a very comfortable life. In addition, many Japanese researchers belong to NIH. The NIH Friday meeting is regularly held with the aim of academic and human exchange with other Japanese researchers.

Because not so many people were in the group, I could communicate closely with each member. As a result, experimental operations and things related to daily life were carefully supported.

【Acknowledgements】

I would like to thank JST Strategic Basic Research Programs CREST for financial support of this dispatch. I appreciate Dr. Murali Krishna Cherukuri for kindly accepting me in RBB and fruitful discussion, and Dr. Kazutoshi Yamamoto and Dr. Tomohiro Seki for their support. Finally, I acknowledge Prof. Shinsuke Sando and Dr. Hiroshi Nonaka for giving me such a great opportunity.