MERIT Long-Term Overseas Dispatch Program

Department of Chemistry and Biotechnology, School of Engineering
Aida Laboratory (D3)
MERIT 4th Generation Student
Koki Sano

【1 Abstract】

I stayed and conducted research at the laboratory of Prof. Robert J. Macfarlane in the Department of Materials Science and Engineering, MIT (June 28th, 2018 ~ November 6th, 2018; December 13th, 2018 ~ January 14th, 2019).

【2 Research Background】

In living systems, many kinds of anisotropic nanocolloids self-assemble into three-dimensionally well-ordered hierarchical structures, and their precise control results in advanced functions. It is one of the biggest objectives in the field of materials science to artificially constructing such sophisticated system and achieve innovative functions superior to biological systems. In Macfarlane lab, they succeeded in constructing and controlling three-dimensionally well-ordered hierarchical structures of isotropic nanocolloids with functional polymers on their surface by making the best use of the interactions between the nanocolloids. In this MERIT long-term overseas dispatch program, I planned to construct hierarchical structures of anisotropic nanocolloids that cannot be realized by isotropic nanocolloids and investigate their dynamic optical properties by applying this concept to anisotropic nanocolloids showing anisotropic interactions.

【3. Research Progress】

At first, I synthesized gold nanorods with various aspect ratios by using seed-growth method and confirmed that their size distribution is narrow enough for further experiments by transmission electron microscopy (TEM) and UV-Vis-NIR spectroscopy. Next, I synthesized polymer ligands with functional groups by

using atom transfer radial polymerization (ATRP). Then, I modified these polymer ligands on the surface of the obtained gold nanorods via ligand exchange and induced self-assembly of the modified nanorods in an appropriate solvent, affording assembled structures of the nanorods. Small angle X-ray scattering (SAXS) measurements of the resultant assembled structures at the synchrotron radiation facility gave scattering profiles with multiple high-order peaks. By analyzing these profiles, it is indicated that the gold nanorods assemble into anisotropic colloidal crystalline structures with high structural integrity. Finally, I demonstrated that the assembled structures could be changed by applying external stimuli, thereby showing reversible modulation of their optical properties. Now that almost all experimental data were obtained, I am preparing manuscript of this work with Prof. Robert J. Macfarlane.

【4. Life in Boston】

Boston is located in the northeast part of the US and one of the oldest cities in the US, and there are many Universities, including MIT and Harvard University. I led a pleasant life in Boston because it is a safe and prospering city. Especially, I did not have to worry about food issues because of a huge grocery store near my house, and I enjoyed sightseeing without a car because of a subway station near my house. In the laboratory, all the members friendly accepted me, and I felt very comfortable with the at-home atmosphere. They kindly taught experimental operations and anything about my life. I learned many knowledges in the different field at weekly meetings.

【5. Acknowledgement】

I would like to thank Prof. Robert J. Macfarlane for kindly accepting me in his laboratory and lab members for fruitful discussions. I also acknowledge MERIT program for giving me such a great opportunity. Finally, I express my gratitude to Prof. Takuzo Aida for various supports.