

STEPS Students Report

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The subjects of my research at Professor Tolstoy's group was the successive ionic layer deposition of gold nanoparticles on substrates. In his lab, the method called successive ionic layer deposition has been developed and used to deposit metal nanoparticles on a substrate. In this method, a substrate is immersed into one solution and washed with water, then it is soaked into the other solution and washed again with water. This series of processes is regarded as one cycle, and the diameter of metal nanoparticles becomes larger as the number of the cycles increases. Therefore, metal nanoparticles with the desirable diameter can be realized by changing the number of the cycles properly.

The goal of my research was to deposit gold nanoparticles uniformly on a substrate keeping their size smaller than 5 nm. In order to achieve this aim, an organic polymer which protects the surface of gold nanoparticles was dissolved in the solutions which contain gold and a reducing agent, and successive ionic layer deposition was conducted. The resultant substrates were observed with a scanning electron microscope. In the observation, the substrate prepared with 10 deposition cycles had larger gold nanoparticle than the one prepared with 5 deposition cycles, so the diameter increased with the number of the cycles. Furthermore, the gold nanoparticles covered with the organic polymer had smaller diameters, 5-25 nm, than those unprotected, 9-40 nm. From this result, the organic polymer seemed to be useful in preventing gold nanoparticles from aggregation and keeping their diameters small. In this study, the size of polymer-protected gold nanoparticles was not sufficiently small and it was not uniform. By reducing the number of deposition cycles, the size can be decreased. According to some previous reports, uniform gold nanoparticles were prepared when a gold species, a reducing agent and an organic polymer coexisted in one solution. This suggests that it would be possible to realize uniformity if polymer-protected gold nanoparticles are prepared in one solution in advance and then deposited on a substrate.

In the middle of this program, I attended The Second STEPS Symposium on Photon Science held in Peterhof. The researchers from Moscow State University, Saint-Petersburg State University, and The University of Tokyo gathered and made presentations about their own researches. Although I myself didn't make a presentation, I was able to obtain a lot of cutting-edge knowledge by asking questions and having discussions with the

researchers. I was also glad to see Professor Yamanouchi and other researchers from our university.

In the course of research, I sometimes had to make proposals on my research topic to Professor Tolstoy. Through this process, I reflected what I really want to study and read a lot of theses, then made some presentations and discussed with him. These processes were very hard but at the same time meaningful to me.

Thanks to this program, I had opportunities to reconsider my future and to acquire knowledge of various fields of chemistry. In addition, I was able to make Russian friends and to learn the culture and the history of Russia. This experience will surely be a precious treasure in my life.

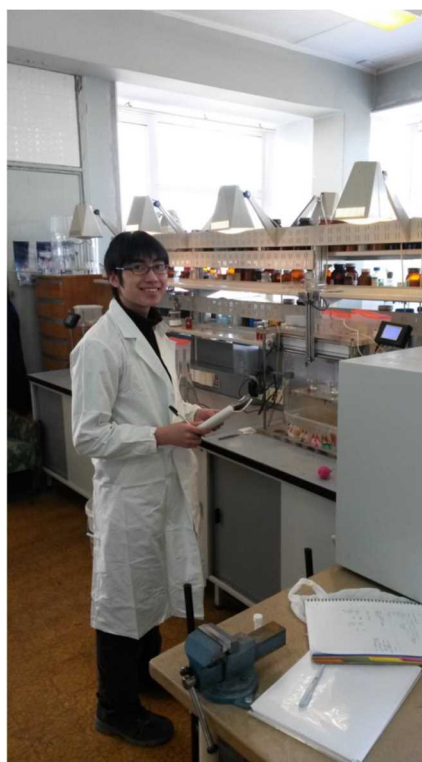


Figure. 1 In the lab, during an experiment