COE Internship Report

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I visited and stayed Professor Patrick R. Unwin's laboratory (http://www.chem.warwick.ac.uk/electrochemistry/index.htm) in the University of Warwick (UK) for a month (from January 5 to February 5, 2003).

The title of my study in COE Internship Program was "Electrochemical Deposition of Single Nano-Particle at Liquid/Liquid Interface". Professor P. R. Unwin and his postdoctoral fellow, Dr. J. D. Guo supported me well about experiments. They have tried to detect the deposition of silver electrochemically at liquid/liquid interface formed at the outlet of a micropipette by the scanning electrochemical microscope (SECM). In my study, the SECM was used for the detection tool. To detect single silver nano-particle, we tried to prepare the nano-pipette which diameter of the outlet was less than 1 μm. Using the laser puller system, I fabricated a lot of, maybe over 100, nano-pipettes. It was easy to prepare a couple of micro- and nano-pipettes by the puller, but it had low reproducibility. Therefore, it was difficult for me to prepare the identical 20 nano-pipettes.

It is a matter of course that how to prepare sample solutions is same in Japan and in UK. An aqueous solution of silver ion was injected into a pipette, and this pipette was inserted into the 1,2-dichloroethane solution (organic phase) containing reductant of silver. I conducted cyclic voltammetric (CV) measurements repeatedly for this two-phase system. To detect the deposition of single silver nano-particle electrochemically at liquid/liquid interface, it is important to choice the reductant which reduces silver ion under applying electric field. It became clear that the reduction of silver by hydroquinones occurred spontaneously and a derivative of ferrocene was suitable for our purpose.

The chronoamperometric measurements were conducted with the two-phase system containing a silver-ferrocene redox couple. The formation of silver particles (reduction of silver) at the interface formed at the outlet of nano-pipette was measured as the change in current. It was revealed that just after applying electric field, the current was quite low and then suddenly increased. These phenomena occurred randomly in a series of measurements. Since time was limited, I could not confirm that the increase of the current corresponded to the formation of single silver nano particle. However, it was proved that this nano-piptte/SECM method had a potential to

deposit metal nano-particle at the liquid/liquid interface and detect its formation simultaneously.

During my stay in the university, I had many opportunities to discuss about my own study in Japan with the professor, students, and other researchers. Because they have specific skills and opinions different from me, the discussion became very valuable for my future work. In addition, I could study how to work as a PhD research fellow. If possible, I would like to go abroad to study or to work in the scientific field someday.

The University of Warwick.

House for my stay.