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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My research is developing the method which enable measurement of SXAS (Soft X-ray Absorption Spectroscopy) at an ambient pressure condition and observing the surface reaction at the pressure of 1 atm by developing the special sample cell. And I doing it at the KEK-PF which is the synchrotron facility in Japan. In this training program, I have been in the "Elettra Sincrotrone Trieste" which is the synchrotron facility in Italy, and I participated in the experiment conducted in "APE-HE" beamline. Dr. Piero is responsible researcher of the beamline and also, he is the representative of the group for the experiment which I participated. His group developed the sample cell which very similar to the one I developed. The purpose of this training was to find a solution to the problem that the signal currents obtained by using my sample cell has a lot of noise and backgrounds besides sample.

I stayed for two weeks to accommodate their experimental period. In the first week, I learned about the beamline optics (such as gratings, mirrors, and slits), vacuum chambers on the beamline, operation of the software for the measurements, and structure of their sample cell. In this week, I also introduced myself and the problems in my experiment in Japan by using the slides, and we discussed about the phenomenon during the measurement.
In the next week, I participated in the experiments using ambient pressure cell. There were two types of experiments which uses different type of sample cell; one is the experiment with cooling at 1 atm and the other one is the experiment with heating at 1atm. They conducted both experiments alternatively with taking morning and night shifts. I mainly participated in the experiment with heating in the night shift. The contents of the experiments were roughly the same as what I had planned for this training in Japan, and I was able to learn on site as expected.

The most helpful thing in what I learned about their sample cell is the structure of the X-ray window electrode. Their X-ray window electrode had almost the same layout as my sample cell, and only the size of the window and the place where potential is applied were different from mine. Since their system didn't have the problem that I have, one or the other is thought to be the key for my problem. And they didn't need to care discharge between electrodes because their system didn't require a high bias voltage different from mine. For now, I'm going to use the small X-ray window size that they used, and apply a negative potential to the sample as they did. By doing this, I think I will automatically understand what is happening in the cell. I think it's very important that I was able to see with my own eyes a method that actually works.

Regarding the image of phenomenon in the cell during the experiment, by the fact that signal currents obtained similarly when the polarity of the bias voltage to the sample changed from negative to positive, it was confirmed that the gas induced to the cell ionized by the electrons emitted from the sample due to the X-ray absorption. This ionization of the gas is inferred from the results of my experiment in Japan and the amount of ionized gas in their experiment seems to be similar to mine by comparing the intensity of currents. This led to a deepening my

recognition that gas ionization is related to the transmission distance of the gas part rather than the magnitude of the bias potential.

They had conducted many reduction experiments and had a wealth of knowledge about reduction, and they gave me the information about the feature of reduction in the spectrum of titanium oxide which I study. I would like to pay attention to the feature of reduction because there is a possibility that the sample is reduced unintentionally due to the influence of the measurement conditions.

During this training, besides the things which related to the research contents, I have experienced many differences from Japan, such as the beamline structure dedicated to the specific experiment, feature-rich measurement software, clear division of roles between researchers and technicians. Regarding the division of roles, researchers were more subdivided into development and measurement departments, and engineers were divided into electrical hardware, software, and mechanical engineering departments. One thing in common with Japan is that young researchers conduct experiments until late at night (with the exception of the delivered pizza and beer).

In summary, this training was fulfilling as I able to achieve the purpose of obtaining clues to improve my developed equipment. And I could experience the differences and the commonalities between the Japanese and Italian research environments.