COE-INES Business Trip Report

Meeting: 3rd Workshop on Speciation, Techniques, and Facilities for Radioactive Materials at Synchrotron Light Source (Actinide-XAS-2004) + A tour of "Advanced Light Source (ALS)".

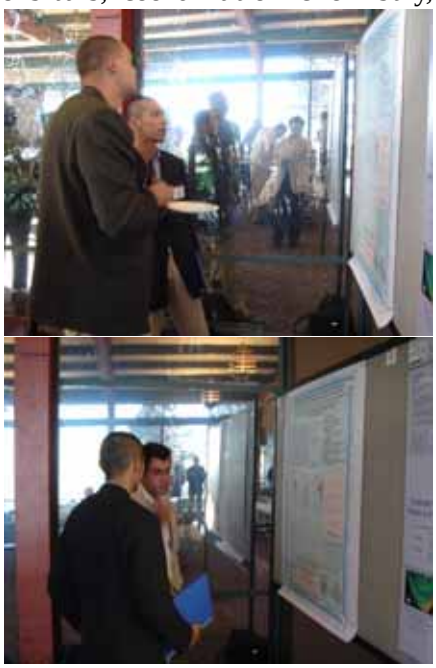
Date: Sep. 13 – 20, 2004

Attendee: 池田 篤史 (原子核工学専攻博士後期課程２年)

Place: Lawrence Berkeley National Laboratory, Berkeley, CA, USA.

I. 3rd Workshop on Speciation, Techniques, and Facilities for Radioactive Materials at Synchrotron Light Source (An-XAS-2004)

Since the synchrotron radiation has been invented, its application has proved a great boon to various research fields. The synchrotron radiation can generate much brighter X-ray than the previous X-ray envelopes, with high directivity. This property of the synchrotron radiation has developed not only ordinary X-ray analytical methods such as X-ray diffraction, but also several new powerful methods. X-ray Absorption Fine-Structure (XAFS) spectroscopy is one of these new X-ray analytical methods developed by the utilization of the synchrotron radiation. XAFS spectroscopy brings us profitable chemical information: chemical properties (oxidation states, chemical bonds) and structural parameters (bond lengths, coordination numbers, ligands). This powerful technique has applied to many research fields and, needless to say, it has also applied to the research works on radioactive materials. The present workshop "An-XAS-2004" mainly focused on the research works of actinides (An) using XAFS spectroscopy with synchrotron radiation facilities, although it also covered the researches for other radioactive materials such as technetium (Tc) by other analytical methods (X-ray diffraction, small-angle X-ray diffraction, X-ray photoemission spectroscopy, etc.) using synchrotron radiation. The topics of the workshop covered a wide range of actinides research: the properties of molecular orbitals, coordination chemistry, crystal properties, solution chemistry, environmental science, etc. These studies are required for understanding the behavior of actinides in nuclear fuel reprocessing and waste disposal.



Poster session

Although it was a small workshop and the number of participants was not so many, all the participants were the leading persons of their research fields. Therefore, all the presentations were very attractive and their discussions were lively. My research work entitled "XAFS analysis of lanthanide species adsorbed in pyridine resin –Adsorption mechanism of lanthanides (actinides) by pyridine resin-" was presented at the poster session held on the evening of Sep 14. The aim of this work is to elucidate the adsorption mechanism of the trivalent actinides and the lanthanides by a pyridine resin. Recently, it has been found in our study that the pyridine resin is a very powerful separating reagent for the

partitioning of the trivalent actinides and the lanthanides [ref. 1-4] and improving the separability of this reagent requires a detailed understanding of its adsorption mechanism. In the presentation, the chemical species of several lanthanides (Nd, Sm and Er) adsorbed in the pyridine resin were determined by XAFS spectroscopy and compared with those in solution, as shown in Fig. 1. On the basis of the results obtained, it was concluded that the adsorption of the lanthanides (and the trivalent actinides) was probably caused by the dehydration of these cations due to the hydrophobicity of resin matrix. Several people showed interests in my work and profitable discussions were obtained.

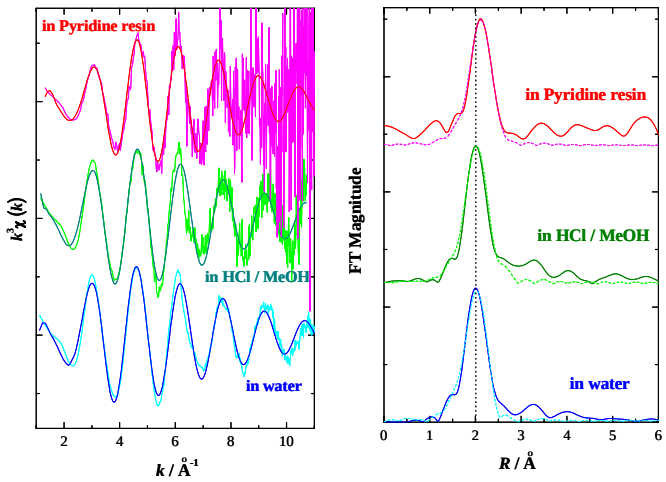


Fig. 1 Nd-L_{III} EXAFS and corresponding fourier transforms for solution samples and resin sample.

II. A tour of "Advanced Light Source (ALS)"

The Advanced Light Source (ALS), a division of Lawrence Berkeley National Laboratory, is one of the famous synchrotron radiation facilities. This facility is known as one of the world's brightest sources of ultraviolet and soft x-ray beams, and the world's first 3rd-generation synchrotron light source in its energy range.

Bird's-eve view of ALS

In the tour of ALS, I was impressed by the following three things: Although 46 beamlines (including the line for linac) are installed in a small building (it is probably smaller than Photon Factory @ KEK), I never felt cramped in the building and I could even feel open-doored. This was maybe because the building had many windows. There are few windows in Japanese synchrotron radiation facilities, such as Photon Factory @ KEK or Spring-8, and sometimes we feel gloomy during experiments. In addition to these windows, there were many female researchers working for the facility. We can also find many women in the Japanese facilities, but most of them are students and there seem to be few female researchers. I got the strong feeling of the equality of the sexes in the U.S. and I think that we should still learn this matter from the U.S. I was also surprised by the surroundings in a controlled area. The inside of the facility is restricted as "controlled area", as well as the Japanese facilities. Nevertheless, we can eat and drink just besides the experimental hutches during experiments. Moreover, there were coffee makers and microwave ovens in the controlled area as shown in the above photo.

Coffee maker and microwave oven
(in a controlled area!!)

Needless to say, we are not allowed to eat or drink in controlled areas of the Japanese facilities. I felt a king of “culture shock” for these differences between the American facility and the Japanese ones. Concerning the performance of the facility, ALS generates high-intensity of x-ray (especially ultraviolet and soft x-rays) due to 8 insertion devices (7 undulators and 1 wiggler) installed, although the size of the facility is almost the same as Photon Factory @ KEK. Therefore, many experiments performed at ALS appeared to focus on the study of the electronic properties of atoms (especially light atoms such as C, N, O, etc.) using ultraviolet and soft x-rays.

Through these workshop and tour, I obtained a lot of profitable information not only about the forefront studies of actinides by XAFS, but also about the research environments in the U.S. I greatly appreciate the 21st century COE program (COE-INES) to give me such valuable experiences.

References

1. T. Suzuki, M. Aida, Y. Ban, Y. Fujii, M. Hara, T. Mitsugashira, *J. Radioanal. Nucl. Chem.*, 255 (3), 581 (2003).
2. A. Ikeda, T. Suzuki, M. Aida, K. Ohtake, Y. Fujii, K. Itoh, M. Hara, T. Mitsugashira, *J. Alloys Compd.*, 374(1-2), 245 (2004).
3. A. Ikeda, T. Suzuki, M. Aida, Y. Fujii, K. Itoh, T. Mitsugashira, M. Hara, M. Ozawa, *J. Chromatog. A*, 1041(1-2), 195 (2004).
4. A. Ikeda, T. Suzuki, M. Aida, K. Otake, Y. Fujii, K. Itoh, T. Mitsugashira, M. Hara, M. Ozawa, *J. Nucl. Sci. Technol.*, 41(9), 915 (2004).