



Contribution ID: 20

Type: Oral

Actinide and radionuclide speciation by X-ray absorption spectroscopy methods at ANKA – A facility report

Thursday 22 May 2014 14:00 (20 minutes)

X-ray Absorption Spectroscopy (XAS) and related techniques have become essential ingredients for many speciation studies on radionuclides in various technical, (geo-)chemical, biological or environmental systems over the past two decades. The high applicability of XAS in the field of radionuclide research is mainly attributed to its ability to provide direct speciation information on a selected element without (or with just a minimum of) sample pre-treatment or target element isolation. At the same time adequate sample containment is easily provided, due to the penetration strength of medium to hard X-rays. XAS has attracted an increasing number of researchers in nuclear sciences with a focus on the nuclear waste repository safety case, but also covering fundamental actinide studies. However, this trend is counteracted by the limited access to the few, strongly overbooked synchrotron X-ray facilities in the world equipped with technical infrastructure, radiation safety expertise and sample handling know-how required to perform XAS measurements on radioactive materials with activities beyond the specific exemption limits.

KIT at Karlsruhe, Germany, provides dedicated synchrotron beamline facilities for the investigation of radionuclide containing samples and controlled area labs in close proximity on the same research campus. Research efforts at the INE-Beamline [1] at the KIT synchrotron light source ANKA [2] are driven by the Karlsruhe based institutes KIT-INE and JRC-ITU and various national and international user groups - many of them applying for beamtime in the frame of joint research projects funded through the EURATOM FP7 access initiative ACTINET-i3 or its follow-up TALISMAN [3]. Operational since 2005, the INE-Beamline offers sufficient flexibility to adapt sample environments and detection systems to many specific scientific questions, including recent implementation of high resolution X-ray emission spectroscopy (HRXES). CAT-ACT, a new X-ray beamline at ANKA for CATalysis and ACTinide research, is currently being constructed and will be jointly operated by KIT-ITCP (Institute for Technical and Polymer Chemistry) for in-operando catalysis experiments and KIT-INE for radionuclide research. CAT-ACT will help serve growing demand to establish additional capabilities for high flux / high energy spectroscopy measurements at ANKA, complementing the existing, strongly overbooked XAS, SUL-X and INE endstations. The new beamline comprises two alternately operated experimental stations at a superconducting high-field wiggler in a 1m straight ANKA ring section next to the INE-Beamline. The CAT-ACT wiggler source provides a spectrum extending into the hard X-ray regime beyond 50 keV, thus giving access to actinide L1- and lanthanide K-edges to Gd. At the same time, the photon flux increase by about two orders of magnitude compared to ANKA bending magnet Radiation at, e.g., the Pu L3-edge will improve HRXES studies requiring high photon flux, as well as increase the spectroscopic sensitivity for dilute sample systems, e.g., for far field studies or radionuclides in environmental samples. The CAT-ACT beamline at ANKA is scheduled to start regular user operation at the beginning of 2016.

[1] J. Rothe, S. Butorin, K. Dardenne, M. A. Denecke, B. Kienzler, M. Löble, V. Metz, A. Seibert, M. Steppert, T. Vitova, C. Walther, H. Geckeis (2012). The INE-Beamline for actinide science at ANKA. Rev. Sci. Instrum., 83, 043105

[2] www.anka.kit.edu

[3] www.actinet-i3.eu

Primary author: Dr ROTHE, Joerg (Karlsruhe Institute of Technology - Institute for Nuclear Waste Disposal)

Co-authors: Dr DARDENNE, Kathy (Karlsruhe Institute of Technology - Institute for Nuclear Waste Disposal); Dr VESPA, Marika (KIT-INE); Prof. DENECKE, Melissa (Dalton Nuclear Institute, The University of Manchester); Mr PRUESSMANN, Tim (Karlsruhe Institute of Technology); Dr VITOVA, Tonya (Karlsruhe Institute of Technology - Institute for Nuclear Waste Disposal)

Presenter: Dr ROTHE, Joerg (Karlsruhe Institute of Technology - Institute for Nuclear Waste Disposal)

Session Classification: Facility Reports and Upcoming Techniques

Track Classification: Facility Reports and Upcoming Techniques