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ACTINET
A NETWORK FOR ACTINIDE SCIENCES

EURATOM

!! DRAFT !!

Pooled Facilities

ACTINET

- Commisariat à l'Énergie Atomique/Centre Nationale de Recherche Scientifique
- Forschungszentrum Karlsruhe – Institut für Nukleare Entsorgung
- Joint Research Center - Institute for Transuranium Elements
- Studiecentrum voor Kernenergie/Centre D'Étude de L'Énergie Nucléaire
- Forschungszentrum Rossendorf – Institut für Radiochemie
- Paul-Scherrer-Institut – Labor für Entsorgung

ACTINET pooled facilities

ACTINET: a consortium dedicated to actinide sciences

ACTINET gathers European research institutions ranging from large national laboratories to university departments, thus bringing at the same time major experimental facilities, training experience, academic and applied research capacities, within the broad area of **actinide sciences**

Pooled facilities:

A major objective of ACTINET is to pool parts of the major European facilities (from CEA, JRC-ITU, INE, SCK-CEN, FZR, PSI), and to operate this pool as a **multi-site user facility** easily accessible for selected joint research activities.

The pooled facilities are laboratories that allow handling radio-active material at various levels of activity and under controlled conditions, with access to analytical techniques and charac-terization methods.

Joint research:

ACTINET supports **joint research projects** proposed by teams from the member organisations. These research projects potentially address all the major fields of basic actinide sciences, keeping in mind the potential applications for the production of nuclear fission energy:

- actinides in solution and solid state
- geochemistry of actinides
- irradiated actinide materials

ATALANTE
LN1 Lab

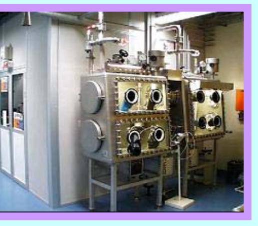
The LN1 Laboratory within the ATALANTE facility in Marcoule is dedicated to molecular chemistry of all actinides in solution, solid state and at interfaces. It brings together selected techniques to obtain structural information, speciation and thermodynamic properties. Four glove boxes are dedicated to classical chemical experiments, such dissolution, dilution, extraction, evaporation, centrifugation, essential to synthesize and purify specific actinide compounds (pure or in specific environment). The nine others glove boxes are specific to prepare samples before the examination through the different techniques.

Mass spectrometry: Brucker Esquire-LC quadrupole ion trap equipped with Electrospray Ionization, and Atmospheric Pressure Chemical Ionization interface. Positive or negative ionization modes can be used. **EI** is useful for metal-ligand analysis (stoichiometry and stability) and **APCI** allows a structural identification of organic compounds.

FTIR and Raman spectrometry: EQUINOX 55 from Bruker. Two detector types have been installed for medium and far infrared. A LabRAM system from Dylor is installed to allow Raman studies. An external continuous-wave 2W Nd-YAG laser, the millennia II, has also been implemented. **FTIR spectrometry** provides information for solid and liquid compounds: metal-ligand vibration energy, coordination of ligands around the metal.

Microcalorimetry: Thermal Activity Monitor microcalorimeter from Thermometric, a modular system with a highly stable temperature-controlled bath containing up to four calorimetry units. The sensor bulbs inserted in the units are capable of measuring heat flows in static or titration systems. **Microcalorimetry** provides information on heats of reaction at low level (some μW), and equilibrium constants of reactions (complexation, extraction, dilution, sorption).

Fluorescence studies: specific laser line using a pulsed Nd-Yag laser (PL8000, Excel Technology), an Optical Parametric Oscillator (Sunlite, Excel technology) and a light frequency doublers (FX1, Excel Technolgy). **This equipment** is well adapted for detection at low level of fluorescent elements like U(VI), Cm(III), Am(III)) and Eu(III), for speciation with little affined ligand, for the hydration number of the first coordination shell from the fluorescence lifetime.



NMR spectrometry: Varian INOVA 400MHz equipped with three channels, wave form generator, Z-gradient and a 100W proton amplifier for solid samples decoupling. Two glove boxes, next to the magnet room, are dedicated to prepare radioactive liquid samples in the NMR tubes. 5mm broad band and reverse commercial probes, both with Z-gradient, are used. a special probe head is under study for experiments with powder samples, such as MAS.
NMR gives access to structure of compounds and dynamic behaviour in solids and solutions.

Diffractometry: 4 circles Brucker ASX Kappa CCD (Nonius), allowing fast data acquisition. The goniometer is equipped with a low temperature device coupled with an air drying system. An optical microscope equipped with a camera is used to fulfill the crystal selection and to introduce it in a quartz capillary. **Single crystal X-ray diffraction** is the key tool in elucidating the geometric structure of solid phases.

The LN1 Laboratory has been commissioned in April 2005. The work on any radionuclide is then be allowed, with limits set by regulations and dose rates at the work bench.

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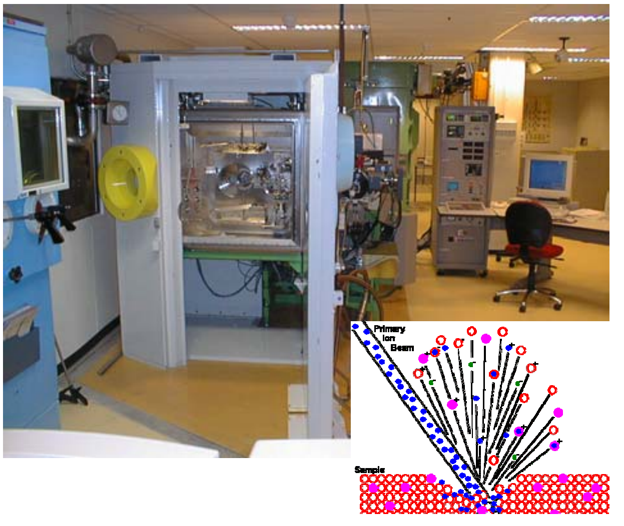
Cadarache
LECA-STAR

The LECA-STAR is a hot laboratory facility designed to perform post irradiation examinations on fuel materials.
It is currently involved in many research programmes on performance, safety and long-term storage of present light water reactors (LWR) fuels, material testing reactors fuels, and nuclear materials for future systems (transmutation targets and fuels, gas cooled reactors, …).

A set of non-destructive examination techniques and material characterization and analysis tools in shielded cells are available and allow a complete characterization of fuel elements.

The LECA-STAR also offers the possibility of simulating various conditions (from storage to reactor transients) with furnaces working in controlled atmospheres and equipped for fission products release monitoring.
The LECA Micro-Analysis Area provides a set of shielded analytical equipments able to characterize highly irradiated fuels :
- a scanning electron microscope (SEM) with a WDS analyser
- a electron micro-probe analyser (EPMA)
-and a secondary ion mass spectrometer (SIMS).

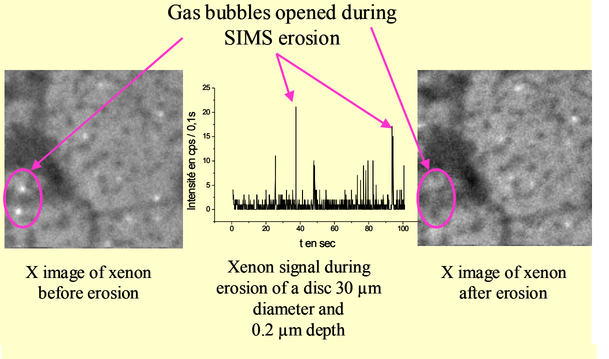


The SIMS is a shielded IMS 6f from CAMECA®. It is a magnetic sector mass spectrometer based instrument, optimised for dynamic SIMS applications, depth profiling and ion microscopy, with ppm to ppb range detection limits. The magnetic spectrometer enables a mass resolution as high as M/DM ~ 10.000 which allows to separate most of the molecular interferences. The standard apparatus was equipped with a glove box and a 10 cm thick lead shielding in order to handle radioactive samples with a dose rate as high as 1 Sv/h.

Low-abundant elements and isotopes in irradiated fuels can be analysed thanks to the SIMS. See « A shielded SIMS in CEA : a new tool for the low abundant isotopes characterization ».

A same sample (typically a slice of irradiated fuel) can be quite easily characterized using the 3 techniques (EPMA, SEM and SIMS) since sample holders are compatible and transfers are easy. This complementarity offers powerful investigation possibilities.

The complementarity of SEM, EPMA and SIMS has been used to develop a new original methodology aiming at characterizing gas (Xe and He) in irradiated fuel bubbles. ***See* « Detection of gas bubble by SIMS in irradiated nuclear fuel » (Text + poster) and « Fission gas inventory in PWR high Burn Up fuel : experimental characterization and modelling ».**



Fission gas bubbles characterization in irradiated fuel using SIMS and EPMA

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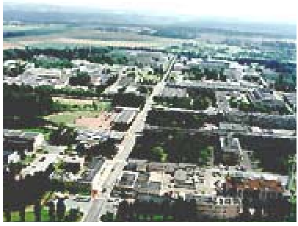
Saclay Analytical Platform

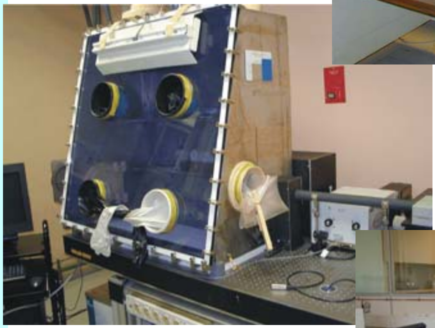


The objectives of the Department of Physics and Chemistry (DPC) of CEA's Nuclear Energy Division in Saclay (France) are the experimental study and the modelling of the processes that determine the behaviour of radionuclides and materials in interaction with their environment, and the development of analytic tools and methods.
In particular, the missions of the Laboratory for the Study of Behaviour of Radionuclides (DPC/SECR, ca. 60 persons) are:
- Study of speciation (characterization, coordination chemistry, measurement of basic thermodynamical and kinetic data…) of radionuclides and molecules in relevant media for nuclear fission energy.
- Experimental study and modelling of migration and transfer of chemical and radio-chemical pollutants taking into account the coupling of chemical reactivity and transport.
- Development and implementation of new techniques and methods for elementary, isotopic and radiochemical analysis, to prepare data measurements and expertises.

A very complete set of analytical tools is available at the Physics and Chemistry Department (DPC) of CEA's Nuclear Energy Division.
The Radionuclides and Molecules Speciation Laboratory (LSRM), with Time-Resolved Laser-Induced Fluorescence (TRLIF) and Electrospray Mass Spectrometry (ES-MS), both under inactive and active conditions (classical chemistry laboratory with all facilities, as well as anoxic gloves box are also available for samples preparation).
The inactive TRLIF, equipped with two different types of lasers and with two types of detector (In situ determinations are also possible with the use of fiber optics and optode), is devoted to uranium and lanthanides speciation studies. The active TRLIF is devoted to curium and americium speciation studies (with temperature control capabilities) as well as for radioactive samples (the sample cell holder is thermostated and within the glove box).

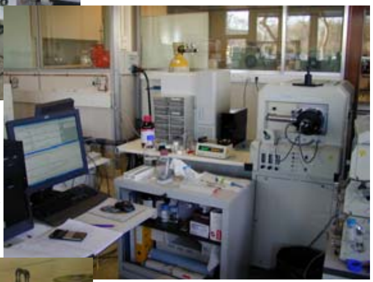
The inactive ES-MS (triple quadripole) is devoted to uranium and thorium speciation studies, while the active one (nano ES-MS triple quadripole) is devoted to plutonium, neptunium, curium, americium speciation studies as well as for radioactive samples. The former ES-MS can be coupled to separative techniques such as high performance liquid chromatography (HPLC).
Aside these speciation tools, classical optical methods such as spectrophotometry, classical fluorimetry and Fourier transform infrared spectrometry are also available.

TRLIF INACTIVE LAB



TRLIF IN GLOVES BOX

ES-MS + HPLC INACTIVE LABORATORY



NANO-ES-MS IN GLOVES BOX

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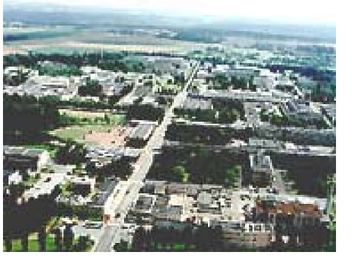
SACLAY

Nuclear Microprobe Hot Beam Line (LPS)



The nuclear microprobe of the Laboratoire Pierre Süe is a joint CEA-CNRS facility dedicated to ion microbeam analysis. This tool is particularly designed to investigate the spatial distribution of trace elements at a broad variety of solid samples. Underlying scientific questions arise from physical, chemical, biological or geochemical studies.

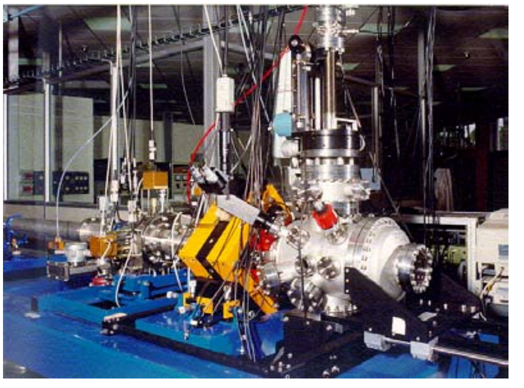
The 3.75 MV Van de Graaff accelerator can produce proton, ^{3}He or ^{4}He beams with energies up to 3.75 MeV or deuteron beams up to 1.9 MeV. Ion beam analysis offers a wide range of analytical characterisations, some of them being performed simultaneously:

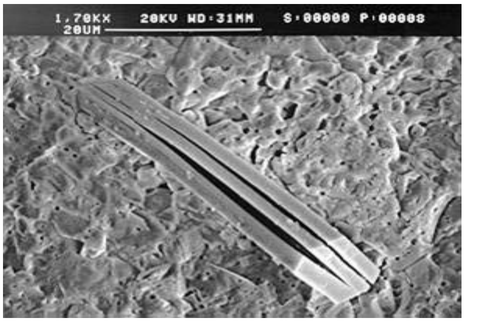
- Particle Induced X-ray Emission spectrometry
- Rutherford BackScattering spectrometry
- Elastic Recoil Detection Analysis
- Nuclear Reaction Analysis

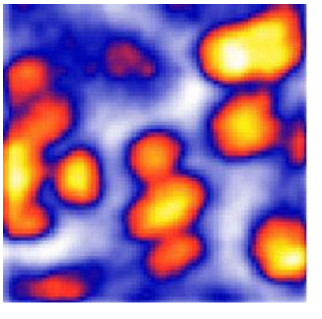
These techniques are used to quantify trace and major elements at a local scale (down to 1 µm² and 10-100 µm depth), from hydrogen to uranium with an emphasis on light elements.

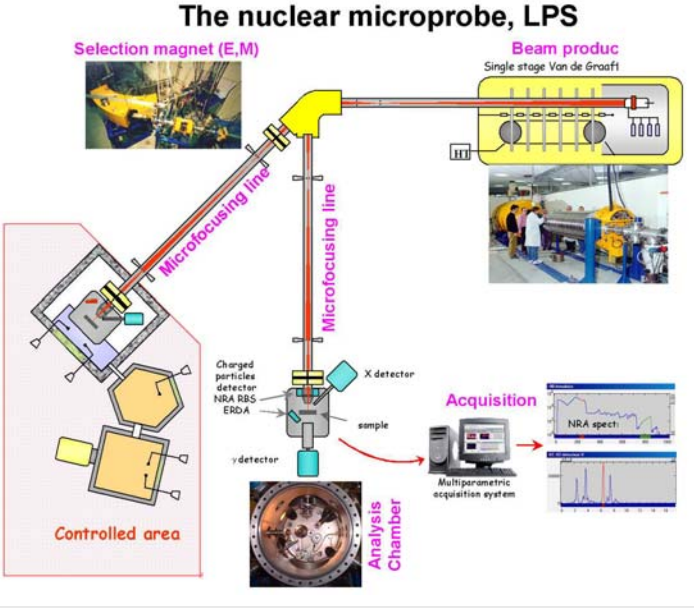
The facility is equipped with two beam lines:

- the first one is used to measure “classical” samples
- the second one, situated in a controlled area, is dedicated to radioactive sample characterization.









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ACTINET
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Forschungszentrum Karlsruhe
in der Helmholtz-Gemeinschaft

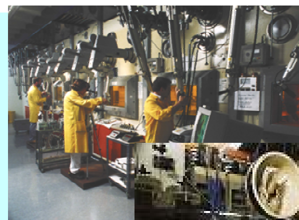
Institut für Nukleare Entsorgung (INE)

Research activities of the INE address questions concerning long-term safety of high level radioactive waste disposal. Crucial fields of the German program for safe nuclear waste disposal, notably the geochemical aspects, are based on work performed at INE. Great expertise is available in actinide speciation by advanced analytical techniques, actinide geochemistry and actinide migration.

List of pooled facilities at INE

Actinide laboratories

- Shielded hot cells (Spent fuel experiments)
- Inert gas glove boxes (e.g. dedicated to migration experiments speciation)
- Classical radioanalytical methods (α, β, γ–spectroscopy, autoradiography)
- ICP-emission spectrometry / Laser-ablation ICP-MS, ICP-mass spectrometry coupled to glove box, Ion chromatography, X-Ray fluorescence, X-Ray diffractometry)
- Scanning electron microscopy, SEM



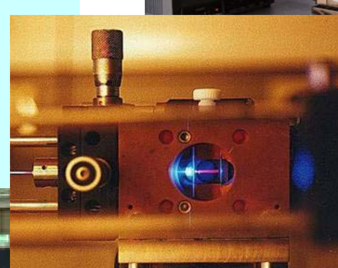
Actinide speciation techniques

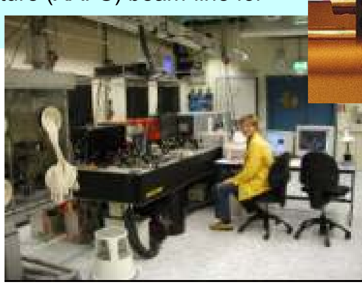
- Chemical speciation (e.g. Capillary electrophoresis-ICP-MS; Field flow fractionation-ICP-MS)

- Photoelectron spectroscopy, XPS, atomic force microscopy, AFM, AFM combined with glove box

- Speciation by laser spectroscopy
    - Time resolved laser fluorescence spectroscopy - TRLFS,
    - Laser induced photoacoustic spectroscopy - LPAS,
    - Laser induced breakdown detection - LIBD
    - partly combined with controlled atmosphere glove boxes

- Multifunctional X-Ray Absorption Fine Structure (XAFS) beam-line for actinides (see separate description)





INE is licensed for and has experimental and technical equipment for working with radionuclides of all types including reactor fuels. Laboratories are equipped to handle radioactive samples, e.g. HLW-glass, spent fuel, alpha emitters.

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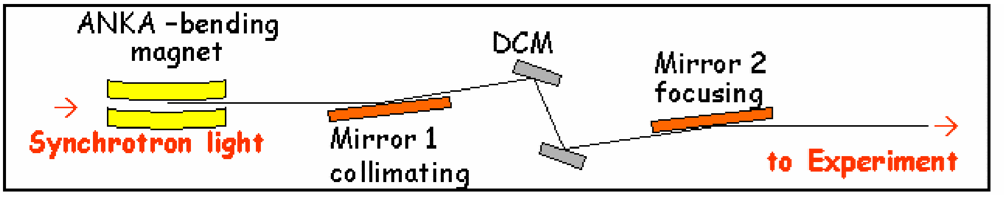
Institut für Nukleare Entsorgung (INE)

INE-Beamline

The INE-Beamline (INE-BL) at the synchrotron source ANKA dedicated to actinide speciation investigations related to nuclear waste disposal as well as applied and basic actinide research. The INE-BL is presently being commissioned and will begin operation in 2005. Experiments on non-fissile nuclides with activities up to 10^6 times the limit of exemption inside a safe and flexible containment concept will be possible. the INE-BL exists and must be adhered to.
The INE_BL is designed to be a a multi-purpose beamline (see Table), with emphasis on X-ray spectroscopic investigations. The available energy range covers key energy regions of interest for investigations of actinides (L3 edges ~16 – 20 keV) and lanthanides as their homologues (L-edges ~5.5 – 11 keV).

Beamline specifics

- Photon energies from the K edge of S (2472 eV) to the Rh K-edge (23220 eV).
- Compact Lemonnier-type double crystal monochromator (DCM) built at the PI-Universität Bonn, allows fast crystal changes.
- Four pairs of crystals are presently available, Si(111), Si(311), Ge(220), and Ge(422).
- Sample positioners / goniometers and auxillary slits for standard XAFS and surface sensitive GI-XAFS.
- 5-pixel solid state detector (Canberra-Packard Ultra-LEGe) available.
- Collimating and focusing mirrors for a sub-mm beam dimension at the sample position. Auxiliary µ-focusing planned (e.g., by refractive or diffractive optics).
- Sealed media feed-through chicanes and separate ventilation / filter system for experimental hutch.
- Access to experimental hutch through lock-room with hand/foot-contamination monitor.
- For more info see www.fzk.de/ine



Some standard INE-Beamline experimental equipment

Standard methods	with monochromatic and wide band-pass beam
XAFS	characterization of bulk species
XAFS/XRD	correlate phase changes with pair distribution changes
XRF	measure elemental concentrations
Surface sensitive	**with grazing incidence (GI) techniques**
GI-XAFS	characterization of surface sorbed species
GI-XRD	identification of secondary phases on surfaces
X-ray reflectivity	determination of surface layer thickness and roughness
TXRF	measure elemental depth profiles
Spatial resolution	**with focused beam for "micro" or µ-techniques**
µ-XAFS	chemical state imaging
µ-XFS	elemental mapping
µ-XRD	identification and distribution mapping of phases
Combination of methods	**combined X-ray methods or X-ray method combined with other techniques, e.g., laser spectroscopy**

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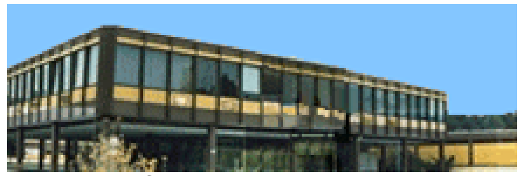

www.itu.jrc.cec.eu.int

Institute for Transuranium Elements (ITU)

The mission of ITU is to protect the European citizen against risks associated with the handling and storage of highly radioactive elements. ITU's prime objectives are to serve as a reference centre for basic actinide research, to contribute to an effective safety and safeguards system for the nuclear fuel cycle, and to study technological and medical applications of transuranium elements.

To fulfill its various tasks, the Institute for Transuranium Elements, part of the Joint Research Centre from the European Commission, is provided with a large number of equipment and unique facilities.
ITU's special facilities consist of 24 hot cells with capacities up to 1 Mio Curies and some 400 glove boxes in 30 alpha laboratories.

Within the scope of the ACTINET Project, the following facilities become accessible*. They are installed in alpha-boxes or are specially equipped for handling actinide compounds. Some of them are also lead-shielded to receive samples with high gamma-activity.

ITU Pooled Facilities

1: Instruments for solid-state properties of actinide compounds

- ^{237}Np Mössbauer spectroscopy
- SQUID magnetometry
- Low temperature and room temperature transport properties at ambient and high pressure (diamond cells).
- High pressure X-ray diffractometry

2: Instruments for the study of thermodynamics, thermophysics and radiation damage

- Low- and high-temp calorimetry
- Electromotive force cell
- Knudsen cell with mass spectrometer and gas-inlet control
- Q-GAMES (quantitative Knudsen cell exhaust gas measurement device)
- Thermal diffusion (LAF)
- Time-of-flight mass spectrometer with sample laser-heating
- Autoclave (7000 bar) with laser heating (melting, phase transition measurements)
- Thermo-optical properties (emissivity/reflectivity from RT to 4000 K)
- Spectro pyrometry (500 channels)
- High-resolution electron microscopy (TEM/STEM/EDAX)

3: Instruments for analytical or solid-liquid interface chemistry

- Scanning electron microscopy (SEM/EDAX) with micro-manipulator
- Electron microprobe
- ICPMS
- SIMS
- XPS, UPS
- Analytical laboratory for traces and ultra-traces
- Autoclaves (up to 80 bar) for leaching experiment with oxygen and hydrogen activity sensors.
- Controlled thin film deposition
- Quartz-nanobalance
- Electrochemistry cells
- Alpha spectrometry

**The use of some of the facilities within the ACTINET may be restricted because they are also allocated to the Actinide User Laboratory, which is funded by other sources.*

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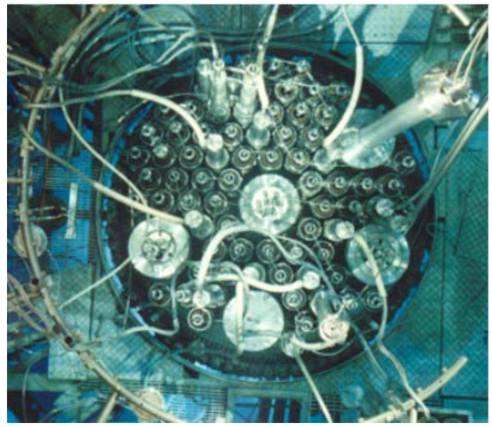
SCK•CEN

STUDIECENTRUM VOOR KERNENERGIE
CENTRE D'ÉTUDE DE L'ÉNERGIE NUCLÉAIRE

SCK•CEN, Foundation of Public Utility, was created in 1952 in order to give the Belgian academic and industrial world access to the worldwide development of nuclear energy.

Since 1991, the statutory mission gives priority to research on problems of societal concern, such as: safety of nuclear installations; radiation protection; safe treatment and disposal of radioactive waste; fight against uncontrolled proliferation of fissile materials; and fight against terrorism.



To fulfill its various tasks SCK•CEN has been provided with a large number of equipment and unique facilities allowing, among others, research on actinides and actinide materials. SCK•CEN's most important installations are the reactors BR1, BR2 and VENUS, hot laboratories and the underground research facility HADES for the study on the disposal of radioactive waste in clay layers. Furthermore, a new accelerator driven neutron source, MYRRHA, is being designed.

Within the scope of the ACTINET Network, the following facilities become accessible*.

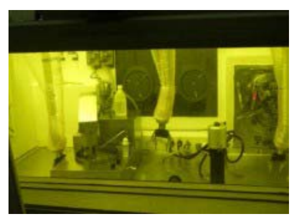
SCK•CEN Pooled Facilities

1: LHMA hot cell facility

Concrete or lead shielded cells equipped with alpha tight inner glove boxes (about 30) for the post irradiation examination (PIE) of fuel rods and core components and allowing the handling of Pu (up to 4 kg fissile material) and minor actinides as present in irradiated fuel

2: Solid state research tools for nuclear samples

- Sample preparation facilities
- High temperature controlled atmosphere furnace
- X-ray diffraction
- Scanning electron microscopy
- Microprobe analysis
- Transmission electron microscopy
- X-ray photoelectron spectroscopy
- Optical microscopy
- Many other facilities for making chemical tests for post irradiation examination of nuclear fuels and targets

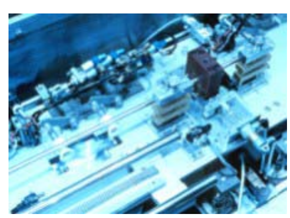


3: Chemical and radiochemical analysis tools for nuclear samples

- Plutonium laboratory with alpha-glove boxes and equipment including inductively coupled, thermal ionization and spark source mass spectrometry, optical emission spectrometry, ion chromatography and UV-VIS spectroscopy
- Alpha, beta and gamma spectrometry
- Liquid scintillation counting

4: Surveyed (<400 MBq of actinides) and controlled (>400 MBq of actinides) laboratories

- 10 alpha glove boxes, most of them with controlled atmosphere (anaerobic, inert, very low oxygen)
- 3 thermostated rooms, equipped for different types of migration and electromigration tests and for batch type experiments (solubility, complexation, sorption) with e.g. Pu
- Tools and facilities to pretreat samples from different waste forms and to prepare doped glass samples
- Analytical equipment including gel permeation chromatography (separation of NOM), luminimeter (measurement of radiolytic products), specific surface area measurement, total and inorganic carbon analyzer and electrochemical equipment



** The use of other experimental equipments and set-ups (BR2, HADES) for the ACTINET Joint Research Projects will also be considered on a case-by-case basis in collaboration with visiting scientists of the ACTINET community.*

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Rossendorf Beamline at ESRF

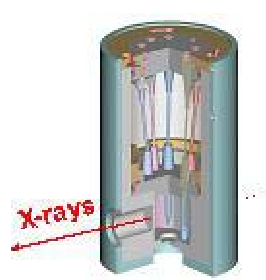
The FZR Institute of Radiochemistry operates an X-ray absorption spectroscopy (XAS) station specifically designed for radiochemical experiments at the European Synchrotron Radiation Facility (ESRF) in Grenoble, France. The objective of this **Radiochemistry Station** is the identification, structural characterization, and quantification of radionuclide species in a wide variety of matrices, ranging from alloys to liquids to environmental samples. Due to the high brilliance of the ESRF and the beamline's solid-state fluorescence detector, a lower detection limit of tens of ppm is achieved (depending on matrix), making this beamline specifically suited to study radionuclides in aqueous and nonaqueous solutions, natural organics, colloids, minerals, microorganisms and plants, and complex systems like soils and sediments.

Equipment

- Monochromator to cover XAS K-edges from vanadium to iodine, and L-edges from iodine to curium (see Table Optics)
- Ion chambers for transmission XAS
- 13-element Ge solid state detector (Canberra) with digital signal processing for fluorescence XAS with high energy resolution and high count rate
- Closed-cycle He croystat for sample cooling down to 20 K
- Spectro-electrochemical cell for in-situ redox modifications
- Automatized sample stage for up to 8 samples
- Radiochemical safety system including a glove box
- Permission to run 18 radionuclides (see list below, upgrades soon)
- A range of certified sample holders for radionuclide samples

Access

- Up to 18 days of inhouse beamtime are provided for collaborations between the FZR and other partners within ACTINET
- Each experiment must be discussed for technical feasibility and safety issues with the responsible beamline scientist before beamtime can be scheduled
- Sample preparation, transport of the samples to the ESRF and back home, and the experiment itself has to meet specific guidelines reinforced by the ESRF Safety Group.



List of permitted radionuclides and maximum amount (blue, in mg). The activity of all samples together has to remain below 185 MBq

Tc-99	**Po-208**	**Po-209**	**Ra-226**	**Th-nat**	**Pa-231**
30,000	0.008	0.3	5	10^6	106
U-nat	**Np-237**	**Pu-238**	**Pu-239**	**Pu-240**	**Pu-241**
10^6	7000	0.3	80	22	0.049
Pu-242	**Am-241**	**Am-243**	**Cm-244**	**Cm-246**	**Cm-248**
124	1.4	25	0.062	17	1,156

Optics

energy range	5 – 35 keV
energy range (Si-mirrors)	5 – 12 keV
energy resolution Si(111)	1.5 – 2.5 x 10^{-4}
energy resolution Si(311)	0.5 – 1.0 x 10^{-4}
integrated flux (at 200 mA)	6 x 10^{11} ph/s @ 20 keV
standard beam size	20 mm (w) x 3 mm (h)
focussed beam size	$\leq$ 0.5 mm x 0.5 mm

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ACTINET
A NETWORK FOR ACTINIDE SCIENCES

FZR Forschungszentrum Rossendorf

Institute of Radiochemistry (IRC)

The goal of radioecological research at the Institute of Radiochemistry is the protection of people and the environement from the hazards caused by radioactive heavy metals, namely the actinides (Thorium, Uranium, Neptunium, Plutonium, Curium and Americium) in the geo- and biosphere.
Applications of the research fall into three major categories:

- development and validation of remediation measures to clean-up the legacy of uranium mining,
- long-term safety assessment of nuclear waste disposals,
- determimation of the environmental behavior of radioactive contaminations due to accidents.

The institute utilizes a broad range of analytical methods. To support our research tasks, a modern laboratory building was brought into operation, containing radiochemical laboratories with state-of-the-art equipment. Another important research facility is our radiochemical beamline ROBL at the ESRF synchrotron in Grenoble/France.

List of pooled facilities at IRC

Actinide laboratories

-Standard and inert gas glove boxes
-Classical radioanalytical methods (α, β, γ–spectroscopy)
-ICP-MS, ICP-mass spectrometry coupled to glove box,

Actinide speciation by laser spectroscopy

Time-resolved laser fluorescence spectroscopy - TRLFS,
(fluorescence lifetimes > 20 ns; U(VI), Cm)
Time-resolved laser fluorescence spectroscopy - TRLFS,
(fluorescence lifetimes < 20 ns; U(IV), Am, Organics)
Laser induced photoacoustic spectroscopy - LPAS,
(220nm – 345nm; 365nm – 690nm, 730nm-1800nm)

IRC is licensed for and has experimental and technical equipment for working with radionuclides, especially acinides (Th, U, Np, Pu, Am, Cm) up to 5 x 10^9 Bq per nuclide.

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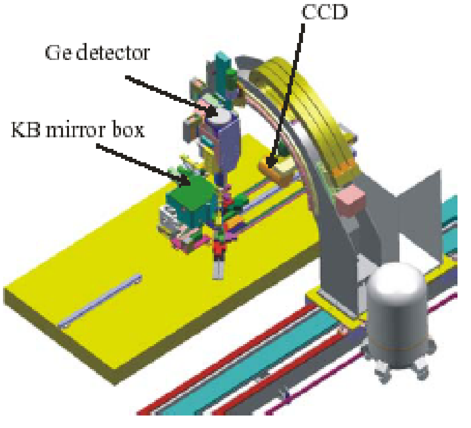
Nuclear Energy and Safety Research Department
Laboratory for Waste Management

MICRO-XAS BEAMLINE AT THE SWISS LIGHTS SOURCE (SLS)

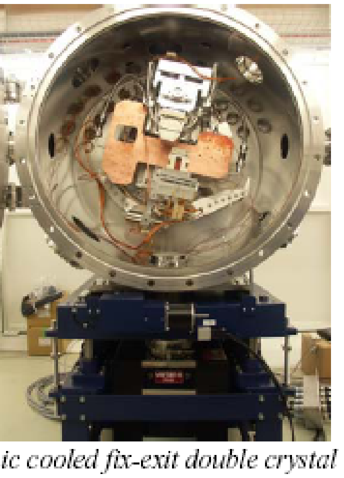
The microXAS beamline at the Swiss Light Source (SLS) is a microprobe facility optimized for X-ray absorption spectroscopy (XAS), X-ray fluorescence (XRF) and X-ray diffraction (XRD) experiments requiring high spatial resolution. It is designed for monochromatic and pink X-ray beams with high flux and energy resolution combined with dynamic (sub-)micron focusing capabilities. As a special feature, the beamline will allow for microXAS measurement of closed radioactive samples with micro-scale resolution. The beamline will be open for Actinet users within the 5th call for proposals.

Beamline Components and Specifics:

- In-vacuum undulator (U19) providing high-brightness X-rays in an energy range (~4 - ~20 keV)
- Rh-coated mirror collimating beam vertically and focusing beam horizontally
- Fix-exit double crystal monochromator equipped with 2 crystal pairs (Si(111); Si(311))
- Kirkpatrick-Baez (KB) mirror system; design goal < 1x1 μm^2
  - beam size adjustable to sample
- Available detector systems:
  - 32-element Ge solid state fluorescence detector
  - wavelength dispersive X-ray detector system (WDX) for experiments requiring the highest energy resolution
  - CCD area detector for diffraction experiments
- Sample manipulator with 6 degrees of freedom:
  - allowing fast XRF elemental mapping
  - suited for Gracing-Incidence X-ray Absorption Fine Structure (GI-XAFS) and X-ray Standing Waves (XSW) experiments
- Measurements of radioactive samples
  - modular concept with local shielding
  - active specimen containment system suited for micro-beam experiment
  - hot laboratory available for a sample receipt and sample loading
  - Under specially arranged conditions access to a Hot Laboratory facility (Typ A laboratories) for preparation of samples can be provided



3D-model of the detector portal showing the Ge-detector in vertical position for the measurements of radioactive samples.



Cryogenic cooled fix-exit double crystal monochromator.

For more information see: www.sls.psi.ch

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