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ABSTRACTS BOOKLET

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- Program
- Oral Communications

Workshop on
“colloids and nanoparticles as REE vectors”

December 13th to 15th 2021
Synchrotron SOLEIL
L’Orme des Merisiers, Saint-Aubin, France

Program

December 13th – Day 1 (Amphitheatre)

09:30 - 10:00 *Arrival and Welcome coffee*

10:00 - 10:30 Welcome and Introduction
Delphine VANTELON, Mélanie DAVRANCHE, Aline DIA, Delphine TALMON

10:30 - 11:30 The main routes of rare earth elements recycling
Juliette SIRIEIX

11:30 - 12:30 Natural colloids and nanoparticles: definition, behaviour and their effects on the fate of trace elements
Mathieu PEDROT

12:30 - 14:00 *Lunch at SOLEIL restaurant*

14:00 - 14:30 ESR6 presentation
Anne BUIST

14:30 - 16:00 Introduction to synchrotron radiation
Valérie BRIOIS

16:00 - 16:30 *Coffee break*

16:30 - 18:00 Introduction to X-ray Absorption Spectroscopy (XAS)
Pierre LAGARDE

19:30 – 21:00 *Diner at SOLEIL restaurant*

December 14th – Day 2 (Amphitheatre)

09:00 – 09:30 ESR1 presentation
Yasaman TADAYON

09:30 - 11:00 Visit the synchrotron
Garance AUBRY

11:00 - 11:30 *Coffee break*

11:30 - 12:30 A small introduction to Small Angle X-rays Scattering: how to characterize Colloids and Nanoparticles – lesson
Thomas BIZIEN

12:30 - 14:00 *Lunch at SOLEIL restaurant*

14:00 - 15:30	(Group 1 – LIBRA Room) Tutorial µXRF imaging data analysis *TD1- Camille RIVARD & Nicolas TRCERA*	(Group 2 – PHENIX Room) Tutorial XAS data analysis *TD2- Valérie BRIOIS & Delphine VANTELON*
15:30 - 16:00	*Coffee break*	
16:00 - 17:30	(Group 2 – LIBRA Room) Tutorial µXRF imaging data analysis *TD1- Camille RIVARD & Nicolas TRCERA*	(Group 1 – PHENIX Room) Tutorial XAS data analysis *TD2- Valérie BRIOIS & Delphine VANTELON*
17:30 - 18:30	Technical textile fibers for industrial water depollution and recycling of metals *Ekaterina SHILOVA*	
19:30 – 21:00	*Conference Diner at SOLEIL restaurant*	

December 15th – Day 3 (Amphitheatre)

09:00 – 10:30	A small introduction to Small Angle X-rays Scattering: how to characterize Colloids and Nanoparticles – demo *Thomas BIZIEN*
10:30 - 11:00	*Coffee break*
11:00 - 12:00	D-DLS a new solution for anisotropic nanoparticle characterization *Sylvain BOJ*
12:00 - 12:30	Summary, Discussion, Outlook, and Farewell *Delphine VANTELON, Mélanie DAVRANCHE, Aline DIA, Delphine TALMONT*
12:30 - 14:00	*Lunch at SOLEIL restaurant*

Oral Communications

OC-01	The main routes of rare earth elements recycling *Juliette SIRIEIX*
OC-02	Natural colloids and nanoparticles: Definition, behaviour and their effects on the fate of trace elements *Mathieu PEDROT*
OC-03	Introduction to Synchrotron Radiation *Valérie BRIOIS*
OC-04	Introduction to X-ray Absorption Spectroscopy (XAS) *Pierre LAGARDE*
OC-05	A small introduction to Small Angle X-rays Scattering: How to characterize colloids and nanoparticles – lesson *Thomas BIZIEN*
OC-06	Tutorial µXRF imaging data analysis *TD1- Camille RIVARD & Nicolas TRCERA*
OC-07	Tutorial XAS data analysis *TD2- Valérie BRIOIS & Delphine VANTELON*
OC-08	Technical textile fibers for industrial water depollution and recycling of metals *Ekaterina SHILOVA*
OC-09	D-DLS a new solution for anisotropic nanoparticle characterization *Sylvain BOJ*

The Main Routes of Rare Earth Elements Recycling

Juliette SIRIEIX PLENET

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ABSTRACT

The supply issue of Rare Earth Elements (REE) has raised increasing concerns for both economic and political reasons. Their industrial importance continues to increase while their production is mainly located in China, which makes the supply potentially vulnerable. REEs are becoming increasingly important in the transition to a green economy, due to their essential role as permanent magnets, lamp phosphors, catalysts, rechargeable batteries etc. The secondary resources such as manufacturing generated waste and end-life products become an eventual resource for REEs.

The recycling of REE is less than 1%. Recycling and/or recovery of REE is mostly limited to permanent magnets, Nickel metal hybride (NiMH) batteries, and fluorescent lamps. Hydro-metallurgical and pyro-metallurgical routes are the two most commonly used REEs recycling techniques.

Here, we will present the different recycling routes to obtain REEs from secondary waste; focusing on the extraction behavior of these elements.

Natural Colloids and Nanoparticles: Definition, Behaviour and their Effects on the Fate of Trace Elements

Mathieu PÉDROT

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ABSTRACT

Colloids are ubiquitous in the Earth's surface environments, from soils to aquatic environments. Of organic or inorganic origin, they are produced by natural processes or contributed by human activities. Environmental physicochemical parameters (pH, redox potential, temperature, pressure, ionic strength, etc.) are the controlling factors of the colloidal mobilization. Although characterized by small size, colloids are mobile and offer diverse surface functions allowing interactions with trace elements.[1] Colloids adsorb heavy metal ions and waterborne pollutants and therefore govern—via their movements in aqueous systems and soils—the fate of reactive elements and/or pollutants. Several studies coupled or not with speciation calculations suggest that a large fraction of trace elements are closely associated with colloids including colloidal organic matter in many natural waters.[2-4] Thus, they play a key role in the biogeochemical cycle of many trace elements. The presence of colloids modifies the physical and chemical speciation of trace elements, and so, their bio-availability and their fate. They can be the main vehicle for their transport. The mobility of trace elements is strongly increased via the genesis and transfer of the colloidal pool in hydrosystems. But, all trace elements do not behave and interact in the same way with the surrounding medium. Some of them are only slightly prone to a colloidal complexation, whereas others are much more involved in such colloid-controlled complexes. Three groups of elements with regard to their mobilization via colloids could be revealed.[4] Nanoparticles, due to their small size, generally have a colloidal status. The colloidal stability of nanoparticles depends on their physicochemical surface properties and the physicochemical properties of the medium.

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1. J.F. McCarthy, J.M. Zachara, Environ. Sci. Technol. 23 (5) 496–502 (1989).
2. R. Dahlqvist, K. Andersson, J. Ingri, T. Larsson, B. Stolpe, D. Turner, Geochim. Cosmochim. Acta 71 (22) 5339–5354 (2007).
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4. M. Pédrot, A. Dia, M. Davranche, M. Bouhnik-Le Coz, O. Henin, G. Gruau, G. J. Colloid Interface Sci. 325, 187–197 (2008).

Introduction to Synchrotron Radiation

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ABSTRACT

Synchrotron Radiation (SR) is an electromagnetic radiation produced from a storage ring by accelerated relativistic particles forced to move along curved trajectories by applied magnetic fields. Basic concepts for the generation of SR will be first presented encompassing a brief description of the storage ring machinery. The uniqueness of the SR properties will be then discussed in comparison with X-ray laboratory sources and with special emphasis on their relevance and opportunities for matter characterization. The ways in which X-rays and matter interacts will be finally outlined.

REFERENCES

Willmott, P. (2011). *An Introduction to Synchrotron Radiation: Techniques and Applications.* Wiley - doi:10.1002/9781119970958

Introduction to X-ray Absorption Spectroscopy

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ABSTRACT

X-ray Absorption Spectroscopy (EXAFS and XANES) is nowadays a major tool implemented in synchrotron facilities for the study of the structural local order in materials science, biophysics, chemistry, geochemistry, in all cases where the system of interest is not enough crystallized to allow the use of diffraction techniques.

In this lecture the basic principles of the technique will be developed: from the simple model describing the EXAFS phenomenon to the more general approach of the multiple scattering and of the XANES domain. A description of the standard experimental set-up's will be presented and finally, I will show several examples characteristic of the use of this technique.

A Small Introduction to Small Angle X-rays Scattering: How to Characterize Colloids and Nanoparticles

Thomas Bizien

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ABSTRACT

X-rays are used to investigate the structural properties of solids, liquids or gels. Basically, photons interact with the sample electrons and provide information about its fluctuations **of electronic densities**.

Small angle scattering experiments are designed to measure I(q) at very small scattering vectors in order to investigate systems with characteristic sizes ranging from crystallographic distances (few Å) to colloidal sizes (up to few microns).

This lecture will introduce what is a saxs setup, comparing Synchrotron beamline to lab saxs setup, followed by a brief theorical introduction to saxs and finally samples analysis and interpretations.

Tutorial: Micro-XRF Imaging Data Analysis Localization of REE in Biological Samples

Camille Rivard[1,2] and Nicolas Trcera[1]

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[2]INRAE, TRANSFORM, 44316 Nantes, France

ABSTRACT

The aim of this tutorial is to show how X-ray fluorescence (XRF) data from LUCIA beamline can be extracted and processed using PyMca[1] software. The participants will learn to open XRF data from Nexus file, to calibrate XRF spectra, to determine elements present in the spectra and to model spectra in each pixel of a map to extract the elemental maps.

Quantitative comparison and basic data treatment operation will also be proposed using Fiji[2] software.

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2. J. Schindelin, I. Arganda-Carreras, E. Frise, V. Kaynig, M. Longair, T. Pietzsch, … A. Cardona. Fiji: an open-source platform for biological-image analysis. Nature Methods, 9(7) (2012) 676–682. (https://imagej.net/software/fiji/)

Tutorial XAS Data Analysis

Valérie BRIOIS & Delphine VANTELON

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Technical Textile Fibers for Industrial Water Depollution and Recycling of Metals

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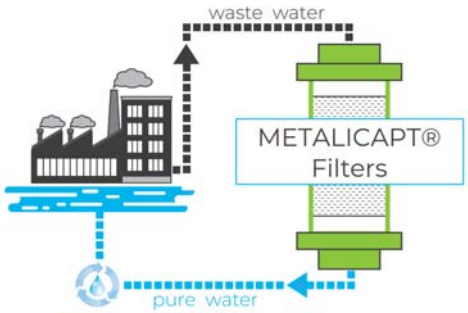
ABSTRACT

The treatment of industrial liquid effluents contaminated by toxic metals has attracted intense interest in recent years, especially for nuclear waste remediation and strategic metals recycling. Standard liquid-liquid extraction is costly and non-eco-friendly process. AJELIS developed a new generations of textile materials and a novel solid-liquid extraction method which is less time consuming, reducing toxic secondary wastes:

- SOLIEX project[1]: development of new ultraselective carbon fibers and processes for the separation of radioactive elements from nuclear waste;
- CYTER project[2]: rare earths recycling by calixarene-immobilized carbon fibers;
- METALICAPT[3]: new nanofibers[4], microfibers[5] and methods for toxic metal removal, nuclear waste decontamination and rare earths extraction.

This new generation of textiles allows selective metals/pollutants capture at a very high speed, over a wide range of concentrations varying from a few hundred milligrams per liter to trace amounts.

AJELIS fibers show better technical and environmental performance than existing solid materials, e.g. granular sorbents or ion exchange resins. AJELIS fiber sorbents are simple, efficient, and environmentally friendly. They enables significate reducing of costs of waste management systems, especially of hazardous ones.



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1. E.A. Shilova, V. Huc, P. Viel. Procédé solide-liquide permettant d'extraire des radionucléides de solutions de déchets. Patent No. FR12305221 (24 février 2012).
2. E.A. Shilova, V. Huc, P. Viel. Nouveaux complexes pour la séparation de cations. Patent No. FR 1452958 (3 avril 2014)
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D-DLS a New Solution for Anisotropic Nanoparticle Characterization

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ABSTRACT

The development of nanoparticles in various fields such as advanced materials is bringing the synthesis of new nanoparticles generation. Carbon nanotubes and graphene are the most famous example.

Only few techniques exist for characterizing these anisotropic nanoparticles. Cordouan Technologies is presenting a new instrument using Depolarized Dynamic Light Scattering technology. This lab instrument allows the measurement of length and width of such nanoparticles.

We are presenting the technology and the very first results of anisotropic nanoparticles.