MSE-676

Multidisciplinary NPs characterization

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Cursus	Sem.	Type
Materials Science and Engineering		Opt.

Language of teaching	English
Credits	2
Session	
Exam	Written
Workload	60h
Hours	**34**
Courses	16
TP	18
Number of positions	**30**

Frequency

Every 2 years

Remark

Block course done at Paul Scherrer Institut (PSI, Villigen) in four days. Please book your room at PSI Guest House well in advance, if needed. Next time: January or February 2028

Summary

Four experienced scientists will guide students into the world of NPs characterization with different approaches, from laboratory characterization to X-ray/neutron scattering and electron microscopy. The main knowledge acquired will concern the overview of possible complementary technique.

Content

The course starts with a general introduction, colloidal stability concepts, and laboratory-based characterization techniques. Then, two sections explore wide and small angle scattering (WAXS, SAXS, SANS) and the information about structure, size, and shape that can be collected in dry NPs and colloids with the support of synchrotron light. Finally, the information accessible via electron microscopy are introduced, such as single particle electron diffraction, tomography, spectroscopy. Each topic consists of about four hours of lecture and four hours of practical work. Written test will be done in the evening of the last day.

Major contents:

1. Introduction and laboratory methods for NPs characterization, 10h (Dr. Andrea Testino, MER)
a. Introduction to materials characterization
b. Introduction to NPs synthesis
c. Introduction to colloidal stability
d. PSD via DLS: theory and practice

2. X-ray diffraction/scattering (WAXS,SAXS) methods theory and practice, 8h (Dr. Nicola Casati, Group Leader, Beamline Manager)
a. Introduction to X-ray diffraction / scattering
b. Introduction to X-ray using Synchrotron light
c. NPs characterization via WAXS
d. Pattern refinement techniques

3. X-ray and neutron scattering (SANS) colloidal systems in liquids theory and practice, 8h (Dr. Viviane Lütz Bueno, Instrumental Scientist)
a. Introduction to neutron diffraction / scattering
b. Introduction to small angle diffraction
c. NPs characterization via SAND and SAXD
d. Data analysis

4. NPs characterization via electron microscopy (SEM, TEM, ED, EDX, tomography) 8h (Dr. Elisabeth Mueller, Group Leader,Electron Microscopy Manger
a. Introduction to Electron Microscopy
b. Introduction to single particle analysis
c. Chemical composition and electron diffraction
d. Single particle tomography

Note

This course is the evolution of the previous course MSE 674, now distributed in 4 days and with 2 credits.

Keywords

Nanoparticles characterization particle size; Particle shape; Colloidal stability; WAXS; SAXS; electron microscopy

Learning Prerequisites

Required courses

Basic scientific background

Learning Outcomes

By the end of the course, the student must be able to:

- Assess / Evaluate Assess / evaluate / modify colloidal stability of a suspension.
- Analyze General knowledge on methods for NPs characterization.
- Anticipate Identify which technique is appropriate to assess NPs properties.
- Interpret Critically evaluate information on NPs nature with a multidisciplinary view
- Contextualise
- Classify
- Give an example

Transversal skills

- Communicate effectively with professionals from other disciplines.
- Use a work methodology appropriate to the task.

Teaching methods

ex-cathedra in the morning, laboratory practice in the afternoon.

Assessment methods

Written exam

Resources

Bibliography

Detailed bibliography given with the course notes

Moodle Link

- https://go.epfl.ch/MSE-676