Name of course:
Aarhus University, University of Hamburg and Deutsches Elektronen-Synchrotron joint course: Application of synchrotron radiation in nanoscience

ECTS credits:
5

Course parameters:
Language: English
Level of course: PhD course (Master students are permitted to attend the course)
No. of contact hours/hours in total incl. preparation, assignment(s) or the like:
Contact hours: 55 / Total hours: 130 (Lab work AU: 5, E-learning, preparation, lectures and exercises: 50, Program at DESY: 50, Final report: 25)
Capacity limits: 10 participants. In case of oversubscription, preference will be given to students in the early part of their PhD program.

Objectives of the course:
Synchrotron techniques have become indispensable for a number of research fields, one of which is nanoscience. The immense brilliance of modern synchrotron beams allows for hitherto unreachable resolution and detection limits that are not possible using conventional laboratory based X-ray techniques. During this course students will get hands on experience at two state-of-the-art beamlines at one of the most brilliant synchrotron sources in the world, PETRA III.
In this course the students will get hands on experience with three powerful techniques used in characterization of nanomaterials, Small Angle X-ray Scattering, Powder X-ray Diffraction and Total Scattering/Pair Distribution Function.
The course is divided in two parts:
Part I: The theory and principles behind synchrotron radiation, the specific techniques, and the data analysis will be presented in a number of on-line lectures and on-line exercises. Nanoparticle samples are prepared in a lab exercise at Aarhus University.
Part II: This part of the course will be held at Deutsches Elektronen-Synchrotron (DESY) in Hamburg from Sunday 15th to Friday 20th of October. During this week the students will perform experiments at two state-of-the-art beamlines at the PETRA III synchrotron. Different experiments will be performed for structural characterization of the samples prepared in Part I. The data collected during the experiments will be analyzed during workshop sessions.
During the week in Hamburg there will also be an excursion to the European X-ray Free Electron Laser, XFEL. After completing the program in Hamburg the students have to prepare a report describing the results of the three analyses, including a brief introduction of the theory and a discussion of the strengths/weaknesses of the three techniques. This report will be evaluated.

Learning outcomes and competences:
At the end of the course, the student should be able to:
- Account for the properties of synchrotron radiation used for structural investigations
- Explain the principle behind small angle X-ray scattering (SAXS), powder X-ray diffraction (PXRD) and total scattering (TS) experiments
- Identify the main technical components in the experimental setups and account for their effect on the resulting data
- Account for the how synchrotron experiments are carried out
- Perform data analysis of SAXS, PXRD and TS data
- Discuss the strengths and weaknesses of the three experiments in relation to nanoscience

Compulsory programme:
All e-learning exercises must be completed
Participation in lab exercise in Aarhus is required
Full participation in the program in Hamburg is required
Evaluation essay must be turned in with the final report

Course contents:
See above

Prerequisites:
B.Sc. in nanoscience, materials science, chemistry, physics or similar and enrolled in a PhD or masters program in nanoscience, materials science, chemistry, physics or similar.

Name of lecturers:
Mads Ry Jørgensen, AU
Dorota Koziej, UHH
Ann-Christin Dippel, DESY

Type of course/teaching methods:
Lectures
Laboratory exercises
Data analysis workshops

Literature:
An Introduction to Synchrotron Radiation: Techniques and Applications by Philip Willmott
Additional literature to be announced during the course

Course homepage:
None

Course assessment:
Project report

Provider:
iNANO / Department of Chemistry, Aarhus University
University of Hamburg
Deutsches Elektronen-Synchrotron, Hamburg

Special comments on this course:
- This is a joint course organized by Aarhus University, University of Hamburg and Deutsches Elektronen-Synchrotron.
- It is advantageous to bring a laptop to the second part, at DESY, of the course.
- Transportation from Aarhus to Hamburg on October 15th and back on October 20th will be organized and free of charge.
- Housing in shared rooms at DESY will be available and free of charge.

Time:
E-learning and lab exercise in Aarhus week 38-41
Practical exercises at DESY week 42 (October 15-20)
Exam report due November 10

Place:
Department of Chemistry, Aarhus University. Langelandsgade 140, 8000 Aarhus C, Denmark
Deutsches Elektronen-Synchrotron, Notkestraße 85, 22607 Hamburg, Germany

Registration:
Deadline for registration is August 18th 2017. Information regarding admission will be sent out no later than September 1st 2017.

For registration: http://webforms.au.dk?form=1644

If you have any questions, please contact Mads Ry Jørgensen, e-mail: mads@inano.au.dk