

## Structural Analysis Techniques in Solid State Physics (C001678)

**Course size** *(nominal values; actual values may depend on programme)*

**Credits 6.0**

**Study time 180 h**

**Course offerings and teaching methods in academic year 2023-2024**

A (semester 2)

Dutch

Gent

lecture

independent work

seminar

peer teaching

**Lecturers in academic year 2023-2024**

Dendooven, Jolien

WE04

lecturer-in-charge

Vrielinck, Henk

WE04

co-lecturer

**Offered in the following programmes in 2023-2024**

[Master of Science in Teaching in Science and Technology \(main subject Physics and Astronomy\)](#)

crdts 6

offering A

[Master of Science in Physics and Astronomy](#)

6

A

**Teaching languages**

Dutch

**Keywords**

Solid state, structure, surfaces, microscopy, analytical techniques, morphology, characterization, defects

**Position of the course**

The goal of the course is to make the students acquainted with modern techniques for structural analysis of solid materials. This includes the theoretical background of the different techniques as well as the data analysis and the practical use.

The course is a direct continuation of the courses Materials Physics and Solid State Physics. It is also directly related to almost any dissertation in experimental solid state physics.

**Contents**

- X-ray diffraction for structure determination of crystalline materials: fundamentals, practical use, indexing, phase identification, and pole figure measurements for texture analysis
- Total scattering of X-rays and analysis of the pair distribution function (PDF) for nanostructured and amorphous materials
- Small angle scattering (SAXS) for obtaining structure information on the nanoscale
- EXAFS (Extended X-ray absorption fine structure) for determining the local structure of an atom in crystalline as well as amorphous materials
- Computed tomography with a focus on X-ray CT: micro-CT, reconstruction, visualization and analysis of 3D images, and applications
- EPR (Electron paramagnetic resonance) and ENDOR (Electron nuclear double resonance) for the study of defects using magnetic resonance
- Seminars on selected modern techniques for structural analysis: student seminar on a selected topic

**Initial competences**

Having successfully followed the courses Materials Physics, Solid State Physics, Quantum Mechanics and Atomic and Molecular Physics, or having gained similar

expertise by following other courses.

### **Final competences**

- 1 Apply advanced knowledge of theories, models, methods, techniques, processes and applications in materials research to analyze and solve complex problems.
- 2 Analyze, evaluate and structurally synthesize information from scientific literature on experimental solid state physics.
- 3 Show a professional attitude which is a sign of openness to new scientific developments and their applications in a broad scientific, economic or social context.
- 4 Present personal research, ideas, thoughts, views or proposals appropriately orally or in writing, both in Dutch and English.

### **Conditions for credit contract**

Access to this course unit via a credit contract is determined after successful competences assessment

### **Conditions for exam contract**

This course unit cannot be taken via an exam contract

### **Teaching methods**

Seminar, Lecture, Independent work, Peer teaching

### **Learning materials and price**

Course notes, handouts of presentations in English or Dutch with references to English handbooks and scientific papers. All course materials are made available electronically via Ufora.

### **References**

V. K. Pecharsky, P. Y. Zavaliy, Fundamentals of powder diffraction and structural characterization of materials, Kluwer Academic, Boston (2003)  
C.R. Brundle, C.A. Evans, S. Wilson, Encyclopedia of Materials Characterization, Butterworth-Heinemann, Boston (1992)

### **Course content-related study coaching**

Interactive support using Ufora (forums, e-mail); personally (no fixed consulting hours)

### **Assessment moments**

end-of-term and continuous assessment

### **Examination methods in case of periodic assessment during the first examination period**

Written assessment with open-ended questions, Written assessment open-book

### **Examination methods in case of periodic assessment during the second examination period**

Written assessment with open-ended questions, Written assessment open-book

### **Examination methods in case of permanent assessment**

Oral assessment, Presentation

### **Possibilities of retake in case of permanent assessment**

examination during the second examination period is possible

### **Extra information on the examination methods**

Permanent evaluation: oral presentation in public with question round.

Final evaluation: written exam, open book.

### **Calculation of the examination mark**

Permanent evaluation (30%) + Final evaluation (70%)