Characterization of materials structure by X-ray diffraction techniques

(Year 2, semester II, 15 h, exam)

Lectures given by: Dr Jan Bonarski Ph.D., D.Sc.

1. title: **Nature and sources of the X-rays**
scope: Natural sources, inducing, X-ray tubes, synchrotrons, characteristic and fluorescent radiation, absorption
effect.

2. title: **Diffraction phenomenon of X-ray. Part I**
scope: Diffraction phenomenon and related physical/geometrical laws, diffraction on crystal lattices. Laue equations, intensity of diffracted beam, theories of diffraction, Bormann effect, polarization.

3. title: **Diffraction phenomenon of X-ray. Part II**
scope: Elementary cells of crystallographic lattice, crystallographic indexing, reciprocal lattice and interpretation
of diffraction effects, detection techniques, position-sensitive detection technique, Si-strip detector.

4. title: **Crystallography and diffraction**
scope: Symmetry in the nature, Basic definitions in applied crystallography, stereographic projection, pole figures.

5. title: Crystallographic t**exture. Part I**
scope: Crystallographic orientation, texture components, texture analysis, orientation distribution function and its
interpretation.

6. title: Crystallographic t**exture. Part II**
scope: Modern quantitative texture analysis, calculation of orientation distribution function, demonstration of the
LaboTex software, examples and practical remarks.

7. title: Texture analysis of polycrystalline materials and X-Ray Texture Tomography
scope: Metals, polymers, rocks, bio-materials, fatigue wear, effects of changing deformation router, investigations of metals after severe plastic deformation, EBSD, topography of texture. Texture inhomogeneity,
X-Ray Texture Tomography – principles and application.

8. title: Using X-ray diffraction in materials engineering
scope: Methods of registration the diffraction effects (modes: $\theta-2\theta$, $\omega-2\theta$, ω, 2θ), WAS, SAXS, phase transformation monitored by high/low temperature attachments, high-resolution x-ray diffractometry, perfectness
of crystal, *Laue- and Debye'a-Scherr* patterns, indexing the X-ray pattern.

9. title: X-ray phase analysis
scope: Line profile analysis (program *DAMfit*), identification of superstructure, X-ray phase analysis (qualitative
and quantitative), texture in X-ray quantitative analysis, structure refinement by Rietveld method.

10. title: Other useful methods and the newest achievements in the field of X-ray diffraction
scope: Estimation of stacking fault energy by X-ray diffraction technique, stress analysis, size of crystallites and
lattice distortions, future of X-ray diffraction: free electron laser and high-energy photon beams.

11. title: **Demonstration of the X-ray Laboratory** and a final colloquium
scope: Demonstration of measurement procedures, data acquisition and data processing. Examples. The aim of
the final colloquium is verification and evaluation of knowledge acquired by the students during presented lectures.