Thermodynamics and Kinetics of Materials

Master in Sustainable Materials

CONTACT INFORMATION

Professor/Instructor: Piercarlo Mustarelli
University/Company/Institution: University of Milano-Bicocca
E-mail Address: Piercarlo.mustarelli@unimib.it
Webpage: www.unimib.it

COURSE CONTENT AND INTENDED LEARNING OUTCOMES (ILOs):

The aim of the course is to provide the students with the knowledge and skills necessary to master the complex mechanisms and processes that underlie the phase transformations of materials, both concerning the thermodynamic aspects and the kinetic ones. The knowledge and skills acquired will be applied to some case studies of technological relevance in the field of functional materials.

At the end of the course, the student will be able to:

- Master a set of experimental techniques/approaches to investigate the structure-properties relationships of tranditional and advanced materials

Aligning with the EIT OLOs:

1 = peripherally relevant to the course content; 2 = highly relevant to course content.

- ☐ EIT OLO 1 - Making value judgments and sustainability competencies
- ☐ EIT OLO 2 - Entrepreneurship skills and competencies
- ☐ EIT OLO 3 - Creativity skills and competencies
- ☑ EIT OLO 4 - Innovation skills and competencies – 2
- ☑ EIT OLO 5 - Research skills and competencies – 2
- ☐ EIT OLO 6 - Intellectual transforming skills and competencies
- ☐ EIT OLO 7 - Leadership skills and competencies

This activity has received funding from the European Institute of Innovation and Technology (EIT), a body of the European Union, under the Horizon 2020, the EU Framework Programme for Research and Innovation

Description of how the course covers the EIT OLO(s) and EIT Thematic Areas

This is a basic course which, chiefly through lessons but also with state-of-the-art examples, allows the students to combine different concepts and information to develop new and original research (**OLO 4**) and innovation (**OLO 5**) skills.

ASSESSMENT METHODS AND GRADING SYSTEM

The final assessment is based on an interview in which different student abilities are evaluated.

- During the assessment, the student must demonstrate to know the main principles of the thermodynamics and kinetics of materials (*content-based assessment*).
- The student must also show how the acquired knowledge can be used as a tool for the analysis and the design of materials starting from the structure-properties relationships (*competence-based assessment*, also evaluating **OLO 4** and **OLO 5**).

The grades in the Italian university system are expressed out of **30.** The passing grade is **18/30**.

ASSESSMENT METHOD	WEIGHT ON FINAL GRADE
Class participation	0%
Lab / on-the-field task	0%
Written output(s) (essay, position papers, case study, final exam etc.)	0%
Oral exam	100%

COURSE SESSIONS

Suggested pre-course reading materials: none

Session 1	COURSE
Content	Provide bullet points which describe the contents of the lecture • Introduction. • Phase diagrams of two-components systems. • Order-disorder transformations. • Solid solutions. • Polycrystalline materials, grain boundaries. • Diffusion and Fick's laws. • Heat and matter transport. • Homogeneous and heterogeneous nucleation. Solid-solid transformations. • Diffraction techniques: short and long-range order. • Glass structure and ionic transport mechanisms. • X-Rays absorption spectroscopy: EXAFS, XANES. • Measuring self-diffusion coefficients: PFG-NMR.
Readings	• B.S. Bokstein et al., Thermodynamics & Kinetics in Materials Science, Oxford University Press, Oxford, 2005. • A.R. West, Solid State Chemistry and its Applications, Wiley, Chichester, 2014. • Teacher's slides

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Session 2	FINAL EXAM
Date - hours	JUN 2021, JUL 2021 1st week, JUL 2021 4rd week, SEP 2021, OCT 2021
Content	Please provide a clear description of the final exam • Oral presentation (interview, generally two questions on different topics; 30-45 min)

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