UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Inorganic Strategies for Materials Synthesis

2526-1-FSM02Q030-FSM02Q03002

Aims

Describe and discuss relevant methods for the synthesis of functional inorganic and hybrid organic-inorganic materials, focusing on the choice of precursors and development of suitable process conditions in order to synthesize materials with the required composition, structure and physico-chemical properties.

Knowledge and understanding
Students will acquire basic knowledge about relevant advanced inorganic materials and their synthesis, including synthetic methods and physico-chemical and process parameters upon which the chemical procedures are based.

Applying knowledge and understanding
The students will be able to select approach, method and parameters best suited to fully control and optimise the synthesis of functional materials based on inorganic cores.

Making judgements
The students will be able to identify precursors and suitable process conditions in order to synthesize materials with the required composition, structure and physico-chemical properties.

Learning skills
The student will understand the fundementals of the basic principles of inorganic synthesis and the properties of inorganic and hybrid materials, applying them correctly to the specific design of an inorganic material.

Communication skills
The students will describe orally, clearly and concisely and with correct use of language the fundamentals of synthetic proceduresoh inorganic anh hybrid materials and their properties.

Contents

Synthesis of functional materials (films, fibers, amorphous and porous materials): solid-state reactions, synthesis of solids from the gas phase, synthesis of solids from melts and solutions at low and high temperature, sol-gel processes, hybrid and porous materials, and nanocomposites.

Detailed program

Synthesis of solid functional materials.

Solid-state reactions: ceramic method, carbothermal reduction, combustion synthesis, sintering, solid-gas reactions.
Synthesis of solids from the gas phase: Chemical Vapor Transport, aereosol processes.

Synthesis of solids from liquid phase: glasses, solvothermal and hydrothermal processes. Precipitation.

Sol-gel processes with alkoxysilanes.

Synthesis of porous materials: hybrid organic-inorganic materials (polysiloxanes, polysilsesquioxanes)). Micro-, meso-, macroporisity. Ordered porosity by templating agents: synthesis of mesoporous silica.

Hybrid organic-inorganic matyerials and nanocomposites.

Prerequisites

Chemistry of inorganic materials requires an interdisciplinary approach exploiting general and inorganic chemistry, organic chemistry, physical chemistry (thermodynamics and chemical equilibria).

Teaching form

24 two-hour lectures, in person (Delivered Didactics) will be given in the classroom, supported by video projection of text, schemes, diagrams, pictures and movies.
A lecture/seminar held by a researcher from a company active in the field of inorganic materials is planned.

Textbook and teaching resource

Recommended textbook:
Synthesis of inorganic materials - U. Schubert, N. Hüsing - (2019) - ebook

Reference textbooks:
Hybrid Materials: synthesis, characterization, applications, G. Kickelbick Ed.- (2007) - ebook
Functional hybrid materials - P. Gomez-Romero, C. Sanchez - (2004) - ebook
Sol-gel science: the physics and chemistry of sol-gel processing - C.J. Brinker, G.W. Scherer - (1990)- ebook Solid state chemistry. Compounds - Eds. A.K. Cheetham, P. Day - (1992)

(copies of the textbooks are available for lending from the university library)

Semester

Second semester

Assessment method

The examination is performed through an oral exam to assesses if and to what extent the student has reached the course objectives, based on the capability and fluency during the interview to illustrate in a clear and sound way the topics delivered, together with selected case studies.

Partial exams are not scheduled.

Office hours

On appoitment by email: barbara.dicredico@unimib.it

Sustainable Development Goals

AFFORDABLE AND CLEAN ENERGY | RESPONSIBLE CONSUMPTION AND PRODUCTION