UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Inorganic Chemistry II and Laboratory

2021-3-E2702Q073

Aims

Familiarize the student with structure, chemical bonding and properties of inorganic solids and nature of transition metal ions.

Contents

Bonding in inorganic solids. Electronegativity and chemical bonding in solids. Ionic bonding. Ionic solids (structure, lattice energy, Born-Haber cycle, covalent character in ionic solids). Crystal field theory and ligand field theory. Synthesis and properties of a few classes of inorganic materials. Solid state synthesis, sol-gel synthesis, hydrothermal synthesis, CVD synthesis. Periodic properties and reactivity of oxides and inorganic materials. Silicates, silica, intercalation materials, zeolites, oxides for catalysis.

Lectures in the **laboratory** will deal with the following topics:

- relevance of the study of the crystalline solid state in modern chemistry
- introduction to Mercury CSD software 8visualization of molecules, elementary cell content, crystal structure)
- point symmetry
- bidimensional space symmetry and basics of tridimensional space symmetry
- short introduction to X-ray diffraction: Bragg equation and qualitative analysis of inorganic crystalline solids
- reminder on intermolecular forces with emphasis on the hydrogen bond

Detailed program

Bonding in inorganic solids. Electronegativity and chemical bonding in solids. Ionic bonding. Ionic solids (structure, lattice energy, Born-Haber cycle, covalent character in ionic solids). Crystal field theory and ligand field theory. Synthesis and properties of a few classes of inorganic materials. Solid state synthesis, sol-gel synthesis, hydrothermal synthesis, CVD synthesis. Periodic properties and reactivity of oxides and inorganic materials. Silicates, silica, intercalation materials, zeolites, oxides for catalysis.

Lectures in the **laboratory** will deal with the following topics:

- relevance of the study of the crystalline solid state in modern chemistry
- definition of crystal, unit cell, atomic cell content and evaluation of stoichiometry in crystalline solids
- crystallographic fractional coordinates
- Mercury CSD software; visualization of molecules, cell content, crystal packing with applications to simple molecular systems
- point symmetry: algorithm for classifying molecules in terms of point symmetry
- examples of point symmetries with simple organic and inorganic molecules
- bidimensional spaceal symmetry; interpretation of bidimensional periodic drawings (wallpaper)

- tridimensional space symmetry; basics of tridimensional elements of symmetry
- short introduction to X-ray diffraction: Bragg equation
- qualitative analysis of inorganic crystalline compounds by means of X-ray diffraction of microcrystalline powders; relevance in the chemical industry
- reminder on intermolecular forces with emphasis on the hydrogen bond
- analysis of intramolecular geometries and intermolecular interactions (hydrogen bond) of simple inorganic solids

Prerequisites

Basic knowldedge of general and inorganic chemistry

Teaching form

Laboratory sessions will be performed with computer sessions using free software suitable for the introductory level of the course.

During the COVID-19 emergency, lectures and laboratory classes will be recorded, and available on the elearning platform in asynchronous mode. Weekly meetings will be planned for live discussions with students to support the learning process of the laboratory topics.
At the end of the emergency, standard lessons will be resumed and the usual teaching material will be available on the elearning platform.

Textbook and teaching resource

Lecture notes available in the elearning platform

Semester

Second semester

Assessment method

Oral Exam. Basic knowledge of inorganic solids (structure and properties) and transition metal ions (crystal field theory).

The exam for the laboratory consists of a written report developing the description of the crystal structure (from the chemical point of view, not from the mathematical one) of a simple coordination compound. For the preparation of the report, formatting guidelines will be provided to be followed. The report is individual and must be delivered in paper before the deadline provided by the teacher. The report will be evaluated in thirtieths and will weight as 50% of the final mark.

It is possible to take the exam in English.

During the Covid-19 emergency period, oral exams will be online using the WebEx platform. On the e-learning page of the course a public link will be available for access during the examination.

Office hours

any time by appointment