UCLouvain

lchm2231

2022

Chemistry and functionality of inorganic materials

6.00 credits	45.0 h + 15.0 h	Q2

Teacher(s)	Garcia Yann ;
Language :	English > French-friendly
Place of the course	Louvain-la-Neuve
Main themes	The teaching will cover the following topics: - defects in inorganic solids and their formation mechanisms. - description of the chemical bond in inorganic solids (band theory) - description of electrical properties (conductors, semi-conductors, superconductors), magnetic, optical and photo-physical properties of principal inorganic solids, and the current applications in the growing domain of functional materials.
Learning outcomes	**At the end of this learning unit, the student is able to :** 1 This course is directed to students having a basic formation in inorganic chemistry and aiming to complete their formation by advanced notions in physical chemistry of functional inorganic materials. It aims at giving a fundamental understanding of chemical bonding in solids and at illustrating the various applications that result. The functionality associated to molecular electronics is also covered based on an orbital and structural approach.
Evaluation methods	oral exam (15/20) and oral defense of a project (5/20) with one or several guest international professors.
Teaching methods	Classic or reverse class.
Content	**I. Point defects and non-stoichiometry** : defect types, origin of intrinsic crystalline defects, point defects (Kröger-Vink notation), non-stoichiomety, extended defects. **II. Electronic structure and electrical properties of solids** : bonding in solids (band theory), relation between band structure and electronic properties, semi-conductors, electrical properties of some inorganic solids (MO monoxides of the 3d series, transition metal sulfides MS2), ionic and molecular conductors. **III. Magnetic properties of materials** : basic concepts, molecular magnetism (long range ordering, elastic interactions, models), magnetism associated to conduction electrons, collective magnetism associated to ions (application to metal oxides). **IV. Analysis methods of magnetism** : susceptometers based on a force or induction measurement. Electronic paramagnetic resonance (EPR). Muon spin relaxation spectroscopy (MuSR). Neutron diffraction (structural aspects, spin density maps). X-ray magnetic circular dichroïsm (XMCD). **V. Various magnetic materials and applications** : ferrites, garnets, hard and soft magnets, molecular magnets, spin crossover materials, photo-switches, photo-magnets and hybrid inorganic-organic materials. **VI. Superconduting material**s : metallic conductivity and superconductivity, review of superconductivity, BCS theory, superconducting oxides with a high critical temperature, applications of superconductors. **VII. Optical and dielectric properties of solids** : inorganic lasers, cooperative dielectric properties (ferroelectricity, piezoelectricity).
Inline resources	Moodle website and Teams LCHM2231
Bibliography	- Introduction à la chimie du solide, L. Smart and E. Moore (trad. J.-P. Jolivet), Masson, 1997. - Solid State Chemistry and its Applications, A.R. West, Wiley, 1984. - Molecular Magnetism, O. Kahn, Wiley, 1993. - All useful references are available on the LCHM2231 Moodle website - All slides in colour and in low cost format (for those who want to print it) are available on the LCHM2231 Moodle website. - All documents associated to the class, including former articles, web site links are available on the LCHM2231 Moodle website.
Other infos	**Background** : Inorganic chemistry I and II (CHM 1331 and CHM 2130). Basic notions in crystallography (CHM 1251A). BIRC students without this background have passed succesfully this class. **Information**: The class can be delivered by an invited lecturer.

Faculty or entity in charge	CHIM

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Chemistry	CHIM2M	6		🔍
Master [120] in Chemistry and Bioindustries	BIRC2M	6		🔍