UCL Université catholique de Louvain

LMAPR1231

2014-2015

Process in inorganic chemistry

5.0 credits	30.0 h + 30.0 h	2q

Teacher(s) :	Proost Joris ; Jacques Pascal ;
Language :	Français
Place of the course	Louvain-la-Neuve
Inline resources:	> http://icampus.uclouvain.be/claroline/course/index.php?cid=LMAPR1231
Prerequisites :	LFSAB1101, LFSAB1102, LFSAB1201, LFSAB1202, LFSAB1301, LFSAB1401, LFSAB1302, LMAPR1310
Main themes :	A first part of the course provides an introduction to electrochemical processes, based on previously developed concepts in chemical thermodynamics. The course starts with a description of aqueous, ionic solutions. Next, quantitative expressions are derived that establish the conditions of electrochemical equilibrium for redox reactions occurring at electrode surfaces. Finally, it is explained how, based on the concept of overpotential, classical rate theory can be applied to describe the kinetics of charge transfer at electrodes. Some typical current-potential regimes are discussed, as well as relevant technological applications. In a second part, both the chemical and the electrochemical thermodynamic and kinetic principles will be applied to the processing and the chemical stability of inorganic materials. Most materials in use by mankind are indeed unstable relative to their environment. It is shown that, for understanding and describing this chemical (in)stability, the same thermodynamic and kinetic principles can be used as the ones governing their extraction (corrosion is merely metal extraction in reverse). Specific attention will be given in this part to the construction and interpretation of relevant engineering diagrams.
Aims :	Contribution of the course to the program objectives Having regard to the LO of the programme "Bachelor in Engineering", this activity contributes to the development and acquisition of the following LO : -- AA1.1, AA1.2 -- AA2.3, AA2.6, AA2.7 -- AA4.1, AA4.2, AA4.3 Specific learning outcomes of the course More specifically, with respect to the disciplinary LO, the student at the end of the course will be able to : -- determine, based on thermodynamic equations and diagrammes, the appropriate operating conditions to produce a metal from its oxidised form, either by reduction in a gaseous atmosphere, or electrochemically in an aqueous medium ; -- identify and derive mass and energy balances for such a process ; -- apply the principles of electrochemical kinetics to understand a number of technological applications (corrosion, electrodeposition, fuel cells). Transversal Learning Outcomes Students will also be able to complete an elaborate exercise as a written examination under time constraint, as well as explain in their own words a theoretical concept during a final examination. *The contribution of this Teaching Unit to the development and command of the skills and learning outcomes of the programme(s) can be accessed at the end of this sheet, in the section entitled “Programmes/courses offering this Teaching Unit”.*
Evaluation methods :	For the coursework (volume 1), the examination is either in written form or orally, the latter with time for preparation on paper (to be determined every year, depending on the number of students). For the exercises (volume 2), a separate written exam will be organised during the semester, counting for 25% of the final score.
Teaching methods :	The course is based on lectures and on exercises-based learning, the latter using a common thermodynamic database. Courses are intended to be very interactive, using an electronic voting system to follow up on students level and advancement in understanding. A one-day visit to an industrial processing plant is scheduled as well, typically an integrated steelmaking factory, to illustrate blast furnace and convertor processes.
Content :	Part 1 : Processing and chemical stability of inorganic materials : -- Ellingham, Kellogg and Chaudron diagrams, for predicting high temperature reactivity of inorganic materials in gaseous environments ; -- Pourbaix diagrams, for predicting low temperature reactivity of inorganic materials in aqueous solutions ;

	-- Applications : the relative stability of oxides, the working principle of a blast furnace, corrosion processes. Part 2 : Electrochemical processes : -- description of ionic solutions and ion-solvent interactions (Debye-Hückel) ; -- structure of electrified interfaces (double layer, zeita-potential) ; -- electrochemical free energy change (Nernst) ; -- overpotentials and electrode kinetics (Butler-Volmer, polarisation curves) ; -- electrode reactions and processes of technological interest (electrodeposition, fuel cells)
Bibliography :	A copy of the course slides is made available to the students, either on i-Campus or via the SICI service. The total contents of matter that is subject to examination is not limited to the course support, but includes everything that has been said or shown during the cours, either orally, on screen or by other media.
Other infos :	The exercise sessions that use a common thermodynamic database, as well as the associated examination, will take place in the informatics rooms of EPL.
Cycle and year of study :	> Master [120] in Environmental Science and Management > Bachelor in Engineering > Master [60] in Environmental Science and Management
Faculty or entity in charge:	FYKI