UCL Université catholique de Louvain

LMAPR1231

2012-2013

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
Prerequisites :	FSAB 1302 : Chemistry and Chemical-Physics 2 MAPR 1310 : Thermodynamics of phase equilibria
Main themes :	The first part of the course deals with the analysis of the thermodynamic and kinetic conditions ruling the phase transformations active during the processing of inorganic materials. Particularly, the nucleation and growth phenomena will be described. Solidification will then be considered before the analysis of the solid state phase transformations. The second 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 the third 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 (phase stability, predominance and transformation diagrams).
Aims :	The objective of this course is to apply chemical and electrochemical thermodynamic and kinetic principles towards the description of the processing and the chemical stability of inorganic materials. At the end of this course, students are expected to be able to: 1. give the thermodynamic and kinetic conditions ruling the phase transformations bringing about the processing of inorganic materials. 2. 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. 3. identify and derive mass and energy balances for such a process 4. apply the principles of electrochemical kinetics to understand a number of technological applications (corrosion, fuel cells,) *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 vol. 1 : Oral exam (with time for preparation on paper) For vol. 2 : Written exam, with use of PC
Teaching methods :	vol. 1 : ex-cathedra courses (part 1 and 2) vol. 2 : exercises (part 2, with the help of dedicated software)
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 application : the relative stability of oxides, and the working principle of a blast furnace Pourbaix diagrams for predicting low temperature reactivity of inorganic materials in aqueous solutions Part 2 : Phase transformations Phase equilibria - Reminder Nucleation and growth Analysis of the phase transformations between dense phases (liquid - solid, liquid - liquid) Solid state phase transformations Part 3 : 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 some electrode reactions and processes of technological interest (corrosion, electrodeposition, fuel cells)

Other infos :	Course materials A copy of course slides is made available to the students. 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.
Cycle and year of study :	> Bachelor in Engineering > Master [120] in Environmental Science and Management > Bachelor in Engineering > Master [60] in Environmental Science and Management
Faculty or entity in charge:	FYKI