UCLouvain

lchm2260

2025

Electrochemical Energy storage

The version you're consulting is not final. This course description may change. The final version will be published on 1st June.

3.00 credits	22.5 h	Q1

Teacher(s)	Vlad Alexandru ;
Language :	English > French-friendly
Place of the course	Louvain-la-Neuve
Main themes	This course will describe the basic principles of design and operation of electrochemical energy storage cells. Different systems will be discussed but the main focus will be on Li/Na-ion chemistries, supercapacitors as well as beyond Li-ion cells. Chemistry, materials, mechanism and theory associated with the electrochemical processes during battery operation will be mainly covered. Manufacturing processes, industrial as well as recent commercial trends will be also discussed. The main topics covered are: theoretical concepts (basic electrochemistry and materials science concepts), the properties of electrode materials in relation to their role in the energy storage, the role of nanoscience in this field, surface and interface processes.
Learning outcomes	**At the end of this learning unit, the student is able to :** This course introduces important concepts in the field of electrochemical energy storage. At the end of the course, the student will be able to : 1 • describe the different families or types of electrochemical energy storage systems that are already in use or are foresees in future use; • provide a rationale for the structure-property selection of battery materials, discuss the mechanisms and reactions at play necessary for efficient energy storage systems operation; • explain and rationalize the properties of battery materials and establish composition-structure-property relationships; and • illustrate the importance of electrochemical energy storage for current societal challenges (energy, environment, mobility, etc.).
Evaluation methods	Students will be assessed on the basis of a written exam covering topics discussed over the entire class.
Teaching methods	The course will be mainly given on the board using powerpoint slides.
Content	1. Introduction and important theoretical concepts - primary, secondary and Li-ion chemistries. 2. Overview of Li-ion battery chemistry, assembly and operation - production processes, aging mechanisms, calendar-life prediction based on modeling. 3. In connection with point 2, an exhaustive overview of cathode and anode chemistries - main families of materials, their synthesis methods and illustration of their application in a Li-Ion cell. 4. Electrolyte classes, function and properties - liquids, ionic liquids, solid-state. 5. The role of surfaces and interfaces. 6. Challenges for next generation chemistries - Na-ion, Li-Sulfur, Li-air, all solid-state, ... The class is essentially based on chemistry and materials concepts applied to solid state electrochelmical processes so a good background is essential for the comprehension of the class.
Inline resources	A copy of the course slides will be made available on Moodle.
Bibliography	Walter van Schalkwijk, Bruno Scrosati, "Advances in Lithium-Ion Batteries", 2002, Kluwer Academic/Plenum Publishers
Faculty or entity in charge	CHIM

Programmes containing this learning unit (UE)				
Program title	Acronym	Credits	Prerequisite	Learning outcomes
Master [120] in Chemistry	CHIM2M	3		🔍
Master [120] of Education, Section 4 : chemistry	CHIM2M4	3		🔍