UCL Université catholique de Louvain

LMAPR2631

2014-2015

Solid surface analysis and treatment

5.0 credits	37.5 h + 15.0 h	2q

Teacher(s) :	Delcorte Arnaud ; Nysten Bernard ;
Language :	Français
Place of the course	Louvain-la-Neuve
Inline resources:	http://icampus.uclouvain.be/claroline/course/index.php?cid=MAPR2631
Main themes :	-- Introduction to Surface Science; -- Electron spectrometries (LEED, AES, XPS) and Ion spectrometries (ISS, RBS, SIMS) ; -- Near field microscopies (STM, AFM).
Aims :	Contribution of the course to the program objectives LO : 1.1, 2.1, 2.3, 5.5 Specific learning outcomes of the course a. Disciplinary Learning Outcomes: Electron and ionic spectroscopies: At the end of the course, the student will be able to -- understand and explain the physical (or physico-chemical) mechanisms underlying the considered spectroscopic and spectrometric methods. These methods include electron spectroscopies (LEED-RHEED, AES, XPS-ESCA) as well as ionic spectroscopies (ISS, RBS) and mass spectrometries (SIMS, LDIMS, MALDI); -- discuss the specifics of each method, compare the information they allow to obtain and their fields of application; -- explain the principle scheme of the different instruments and describe their main components (ex. ion gun, electrostatic analyzer, multichannel detector); -- identify the performance, the limitations (ex. sensitivity, quantification) as well as the possible artifacts related to the different analysis methods, be critical of the data interpretation; -- provide examples of applications of the analytical techniques in the context of surface treatment and processing (ex. PVD, plasma treatments, thin layer deposition); -- select an appropriate method for the structural or chemical analysis of an unknown solid sample; -- justify the choice of method(s) to answer a problem in materials characterization (such as those encountered in the industrial context). Scanning probe microscopies (SPM): At the end of the course, the student will be able to -- identify and explain the physical, chemical and physico-chemical phenomenons at the basis of the functioning of scanning probe microscopies (STM, AFM, C-AFM, LFM, FMM, AM-AFM, FM-AFM, MFM, EFM, PFM, KPFM, '); -- describe the instrumentation and explain the functioning of these microscopies; -- compare them regarding the physical, chemical or physico-chemical properties they allow to measure and map; -- make and justify the choice of the adequate technique to characterize a specific property of a given material; -- explain the artifacts that may bias this type of analysis and to criticize results obtained with one of those techniques on this basis. b. Transversal Learning Outcomes: At the end of the course, the student will be able to: -- critically discuss the experimental results with experts in the considered domains; -- write a concise lab experiment report, structured and adequately illustrated, describing the technical aspects of the experiments, from the sample preparation protocol to the obtained results, in a precise scientific language.

	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 :	Oral examination regarding the competencies that have to be acquired
Teaching methods :	Electron and ionic spectroscopies: 9 lectures of 2h each (including a 1 hour general introduction on surface science) and 2 laboratories illustrating selected techniques (instrumental aspects + data interpretation; reports asked to the students). Scanning probe microscopies (SPM): 5 lectures of 2h each and 2 laboratories illustrating two SPM techniques. For the laboratories, students of 2nd Master are encouraged to bring their own samples.
Content :	1. Introduction ro surface science 2. Electronic and ionic spectroscopies 2.1. Electron diffraction (LEED/RHEED) 2.2. X-ray photoelectron spectroscopy (XPS/ESCA) 2.3. Auger electron spectroscopy/microscopy (AES/SAM) 2.4. Ion scattering spectroscopy (ISS) 2.5. Secondary ion mass spectrometry (SIMS) 3. Scanning probe microscopies 3.1. Scanning tunnelling microscopy and spectroscopy 3.2. Atomic force microscopies 3.2.1. Contact mode microscopies : C-AFM, LFM, FMM, CS-AFM, PFM, ... 3.2.2. Resonant mode microscopies : AM-AFM, FM-AFM, MFM, EFM, KPFM, ... 3.2.3. Instrumental aspects : scanner, probes, artifacts, ...
Bibliography :	Electron and ionic spectroscopies: Slides presented at the lectures, available on iCampus Application notes from the instrument manufacturers List of reference textbooks, available at the library / in the laboratory Scanning probe microscopies (SPM): Upgradeable lecture notes available at SICI and on iCampus Slides presented at lectures, folders and application notes from manufacturers available on iCampus
Other infos :	It is highly recommended to have attended the LMAPR2011 « Methods of Physical and Chemical Analysis » course or an equivalent.
Cycle and year of study :	> Master [120] in Physics > Master [120] in Physical Engineering > Master [120] in Biomedical Engineering > Master [120] in Electrical Engineering > Master [120] in Chemical and Materials Engineering
Faculty or entity in charge:	FYKI