UCL Université catholique de Louvain

LBRNA2202

2014-2015

Nano-biotechnologies

3.0 credits	30.0 h	2q

Teacher(s) :	Dufrêne Yves ;
Language :	Français
Place of the course	Louvain-la-Neuve
Inline resources:	Icampus
Main themes :	At the meeting point between nanosciences and biology, nanobiotechnology aims at creating, characterizing and exploiting biosystems on the nanometer scale. In view of its numerous applications, this fast-moving area is attracting more and more attention both in basic research and in industry. The course aims at providing a survey of the concepts, methods and challenges of nanobiotechnology. Following a general introduction on nanosciences, the course describes the main nanocharacterization and nanofabrication methods. In particular, we show how the tools of nanotechnology (scanning probe microscopies, lithography) can be used to explore and transform biosytems at the level of single atoms and molecules, on the one hand, and how the basic principles of biology (self-assembly) can be used to elaborate new materials and devices, on the other hand. Finally, the applications and perspectives are discussed (biosensors, microfluidics, bioMEMS, quantum dots, nanoparticles, biomolecular machines), together with the main limitations and technological challenges remaining to be addressed.
Aims :	a. Contribution of the activity to the AA (AA of the programme) 1.1, 1.2, 1.4, 1.5 3.1, 3.4, 3.6 à 3.9 6.1, 6.2., 6.4 à 6.7 b. Specific formulation for this activity to the AA of the programme (maximum 10) At the end of this learning activity, the student will be able to: - Explain, with an integrated and transversal vision, the main challenges of nanotechnology and nanosciences in the broad sense (nanoelectronic, nanomaterials, nanobiotechnology), - Explain the principles of the different nanofabrication methods (top-down vs bottom-up), and evaluate their throughput. - Compare the physical principles of nanocharacterization methods (scanning probes, fluorescence), and define their advantages and limitations, as well as their complementarity. - Interpret the data obtained via these different techniques. Justify with examples. - Propose an integrated vision of the main applications of nanobiotechnology (BioMEMS,Nanoparticles, Biomolecular Machines), while speculating on their long term feasibility (science vs science fiction). - Formulate a critical synthesis of scientific articles which represent major breakthrough in nanobiotechnology. - In groups of 2 or 3 students, criticize an article in written (written report of 5 pages) and oral (talk of 15 min) forms. Estimate the strengths and weaknesses of the article. Criticize the methodology, the results (originality, quality, reproducibility and statistics) and their interpretation (is the discussion founded or not). Speculate on the perspectives (basic or applied research) offered by the study. *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 :	Written examination and practical work (written + oral)
Teaching methods :	The theoretical lessons are completed by a critical analysis and presentation of an article, as well as by seminars given by invited speakers, aiming at illustrating the different applications of nanobiotechnology.
Content :	I. Nanotechnology: introduction Definition, history, budgets / Expected applications / From micro- to nanotechnologies / Three main fields : nanoelectronics, nanomaterials, nanobiotechnology II. Nanofabrication methods II.1. Top-down: lithographies Photolithography / Electronic lithography / Soft lithography / Dip-pen nanolithography II.2. Bottom-up: self-assembly and supramolecular chemistry Self-assembled monolayers (SAMs) / Supramolecular chemistry / Nanostructured polymer systems / Q dots / Colloidal lithography / DNA assembly / 2D protein arrays (S-layers) / Lipid films / Layers of adsorbed proteins III. Nanocharacterization methods Scanning tunnelling microscopy (STM) / Atomic force microscopy (AFM) / Scanning near-field optical microscopy (SNOM) / other microscopies at the single molecule level

	IV. Applications and perspectives IV.1. Biosensors, microfluidics, BioMEMS (detection: mechanical, electrical, optical) IV.2. Nanoparticles Quantum dots for bio-imaging / Detection of proteins based on nanoparticles IV.3. Biomolecular machines F1-ATPase / Actin motors / Kinesin motors / DNA nanoactuators
Bibliography :	Notes and articles provided by the teacher and available on iCampus
Cycle and year of study :	> Master [60] in Biology > Master [120] in Chemistry and Bio-industries > Master [120] in Biochemistry and Molecular and Cell Biology > Master [120] in Biomedical Engineering
Faculty or entity in charge:	AGRO