VNIVERSITAT DE VALÈNCIA

Course Guide
44420 Physical nanomanufacturing techniques

COURSE DATA

Data Subject	
Código	44420
Name	Physical nanomanufacturing techniques
Cycle	Master's degree
ECTS Credits	3.0
Curso académico	2017 - 2018

Study (s)

Degree	Center	Acad. year	Period
2208 - M.U. en Nanociencia y Nanotecnolog²a Molecular	FACULTY OF CHEMISTRY	1	First term

Subject-matter

Degree	Subject-matter	Character
2208 - M.U. en Nanociencia y Nanotecnolog²a Molecular	4 - Physical nanomanufacturing techniques	Obligatory

Coordination

Name	Department
CORONADO MIRALLES, EUGENIO	320 - QUđMICA INORGĆNICA

SUMMARY

English version is not available

Se pretende que los alumnos adquieran aquellos conocimientos b§sicos relacionados con la aproximaci· n ascendente para la nanofabricaci· n, en particular las posibilidades y los l²mites de las t®cnicas litogr§ficas como herramienta para la nanofabricaci· n

PREVIOUS KNOWLEDGE

Relationship to other subjects of the same degree

There are no specified enrollment restrictions with other subjects of the curriculum.

Other requirements

There are no specified enrollment restrictions with other subjects of the curriculum.

OUTCOMES

2208 - M.U. en Nanociencia y Nanotecnología Molecular

- Students can apply the knowledge acquired and their ability to solve problems in new or unfamiliar environments within broader (or multidisciplinary) contexts related to their field of study.
- Students are able to integrate knowledge and handle the complexity of formulating judgments based on information that, while being incomplete or limited, includes reflection on social and ethical responsibilities linked to the application of their knowledge and judgments.
- Students have the learning skills that will allow them to continue studying in a way that will be largely self-directed or autonomous.
- Students have the knowledge and understanding that provide a basis or an opportunity for originality in developing and/or applying ideas, often within a research context.
- To possess the necessary knowledge and abilities to continue with future studies in the PhD program in Nanoscience and Nanotechnology.
- For students from field of knowledge (e.g. chemistry) to be able to scientifically communicate and interact with colleagues from another field (e.g. physics) in the resolution of problems laid out by the Molecular Nanoscience and Nanotechnology.
- To know the methodological approaches used in Nanoscience.
- To know the main techniques for molecular systems nanofabrication.

LEARNING OUTCOMES

English version is not available

Se pretende que los alumnos adquieran aquellos conocimientos básicos relacionados con la aproximación ascendente para la nanofabricación, en particular las posibilidades y los límites de las técnicas litográficas como herramienta para la nanofabricación.

DESCRIPTION OF CONTENTS

1. Physical nanofabrication techniques.

1) Introduction: Lithographic techniques in the context of nanofabrication techniques.

2) Optical lithography
2.1.Basic processes and lift-off.
2.2.Thin film deposition of resists by spin-coatting.
2.3.Photoresist exposition through a mask: methods and resolution; techniques for resolution improvement; Photoresists: types, examples, evaluation parameters, chemically amplified photoresists.
2.4. Limits and future of the technique.

3) Etching techniques
3.1 Wet etching techniques
3.2 Dry etching techniques: reactive ion etching (RIE) and variants, sputtering, laser ablation, etc

3.3 Clean rooms.

4) Nanolithography by nanoimprinting and microcontact.
5.1. Microcontact printing.
5.2. Nanoimprint lithography (NIL) and variants: thermal NIL, room temperatura NIL, solvent-assisted NIL, step and flash NIL, etc

5.3. Molding of plastics: hot embossing, injection, etc..

5) Electron beam lithography
3.1 The scanning electron microscope
3.2 Interactions between electrons and matter
3.3 electron beam lithography
3.4 Applications and some examples

6) Scanning probe lithography
6.1 The force microscope
6.2 The variety of Scanning probe lithographies
6.3 Oxidation SPL
6.4 Thermal SPL
6.5 Applications: Silicon nanowire transistors; bimolecular sensors; molecular architectures.

7) The atomic force microscope in biology and material sciences
7.1 Operational principles
7.2 AFM modes
7.3 Forces and spatial resolution
7.4 High resolution imaging of soft matter
7.5 Nanomechanical and single molecule force spectroscopies

8) Focused Ion Beam Lithography and other direct patterning methods
8.1 Introduction to direct patterning Methods
8.2 Laser Beam Lithography
8.3 eBeam assited Patternning
8.4 Focused ion Beam Lithogrpahy

WORKLOAD

ACTIVITY	Hours	% To be attended
Theory classes	15,00	100
Tutorials	5,00	100
Seminars	4,00	100
Other activities	2,00	100
Preparation of evaluation activities	39,00	0
Preparing lectures	10,00	0
TOTAL	**75,00**	

TEACHING METHODOLOGY

- Theory classes, participatory lectures
- Articles discussion.
- Chaired debate or discussion.
- Practical cases or seminar problems discussion.
- Seminars.
- Problems.
- Laboratory practices and demonstracions and visit to installations.
- Experts conferences.
- Attendance to courses, conferences and round tables.

EVALUATION

Written exam about the subject basic contents	70-90%
Attendance and active participation in seminars.	0-10%
Questions answering	10-20%

REFERENCES

Basic

- From Instrumentation to Nanotechnology, J.W. Gardner, H.T. Hingle, Gordon & Breach Publishing Group, 1999.
- Micromachines & Nanotechnology: The Amazing New World of the Ultrasmall, David Darling, Silver Burdett Press, 1995.
- Zheng Cui (Author) Micro-Nanofabrication: Technologies and Applications; Higher Education Press; Springer; 2005.
- E. Menard et al. Micro- and Nanopatterning Techniques for Organic Electronic an optoelectronic system; Chem. Rev. 107, 1117, 2007.
- P. Rai-Choudhury (Ed) Handbook of Microlithography, Micromachining and Microfabrication, Vol. 1, SPIE Optical Engineering Press, Bellingham, WA, 1997
- Kazuaki Suzuki & Bruce W. Smith (Eds.)Microlithography: Science & Technology, 2nd Ed. (Optical Sci. and Eng.); CRC Press, 2007
- D. Xia, Z. Ku, S.C. Lee, and S.R.J. Brueck, Nanostructures and Functional Materials Fabricated by Interferometric Lithography, Adv. Mater. 23, 147 179 (2011).

Additional

- Fundamentals of microfabrication and nanotechnology. M.J. Madou, CRC Press (2011)
- Amplitude modulation AFM, R. Garcia, Wiley-VCH (2010)
- Scanning Probe Microscopy: The lab on a tip, E. Meyer, H. Hug, R. Bennewitz, Springer (2004)
- Advanced scanning probe lithography, R.. Garcia, A.W. Knoll, E. Riedo, Nature Nanotechnology 9, 577-587 (2014)