2EL5110 – Light to understand matter

Instructors: Ninel Kokanyan
Department: CAMPUS DE METZ
Language of instruction: ANGLAIS
Campus: CAMPUS DE METZ
Workload (HEE): 60
On-site hours (HPE): 35,00
Elective Category : Fundamental Sciences
Advanced level : Yes

Description

There are many different characterization techniques that use *light*. Optical characterization techniques are generally non-destructive, fast and simple to implement, requiring very little sample preparation. These methods explore the change of intensity, energy, phase, direction or polarization of the light wave after interaction with the object under study. These techniques are now in great demand in the industrial world (quality control, surface characterization, atmospheric studies, food, biomedical and pharmaceutical analyzes, etc.).
The main purpose of this lecture is to address the most relevant examples of optical techniques with a focus on their applicability, usefulness and limitations. During the lecture will be presented different techniques that can be used in a complementary way and the obstacles that are frequently noticed during their use. Examples of practical and real applications will illustrate these points, offering suggestions on how it is possible to avoid obstacles as much as possible.

Quarter number

SG6

Prerequisites (in terms of CS courses)

1SL3000 - Lecture of quantum physics 1A

Syllabus

1. Introduction
2. Light scattering
3. UV-VIS-NIR spectrophotometry
4. Ellipsometry
5. Interferometry
6. Reflectometry
7. Photoluminescence

8. Infrared spectroscopy and Fourier transform infrared spectroscopy (FTIR)
9. Raman spectroscopy
10. Applications of optical techniques
11. Examples of applications in industry, biology, medicine, nanomaterials,...

Class components (lecture, labs, etc.)
20h of lectures, 6h of tutorials and 8h of practical work

Grading
Continuous assessment: QUIZ (25%), project (25%), final written exam (50%). In case of a justified absence to one of the intermediary examinations, the grade of this latter is replaced by the grade of the final examination.

Course support, bibliography
Mauro Sardela, *Practical Materials Characterization*, Springer-Verlag New York (2014)
Jin Zhong Zhang, *Optical Properties and Spectroscopy of Nanomaterials,* World Scientific (2009)
Peter Lasch and Janina Kneipp, *Biomedical Vibrational Spectroscopy,* A JOHN WHILEY & SONS, INC. (2007)

Resources
LMOPS Laboratory equipments
Teaching team : Ninel Kokanyan, Thierry Aubert

Learning outcomes covered on the course

- To be aware of different optical techniques
- To be aware of the operating principles of different spectroscopic components
- Design and realize a device for optical measure
- Be able to interpret obtained spectroscopic results
- Identify the characterization technique suited for given material as well as for studied parameter

Description of the skills acquired at the end of the course
C1.2 : Develop and use appropriate models, choosing the correct modeling scale and simplifying assumptions when addressing problem
C2.1 : Thoroughly master a domain or discipline based in the fundamental sciences or the engineering sciences
C3.4 : Take decisions in an environment that may not be fully transparent, embracing the unexpected and calculating risk.