

**Optional Unit: Analytical Instrumentation for detection
(3 ECTS) RADMEP/ UJM semester 3**

Course instructor: Ass. Pr. A. Morana, Dr. R. Stoian / Language of instruction: English

Overview

Interaction between light and matter is at the origin of spectacular phenomena driving chemical, physical, morphological and topographical material changes, being at the base of acquiring novel properties and evolution paths. Multiple physical and chemical processes concur to material transformation, their timescales being determinant for the evolution of matter.

The objective of this course is to give an overview of time-resolved optical investigation techniques capable of visualizing the material evolution in real time. These are able to probe materials under light exposure from strong field non-equilibrium excitation to thermodynamic and thermomechanical relaxation. We will introduce various concepts of time-resolved probing of matter active of multiple timescales including ultrafast phenomena. We will explore techniques detecting electronic and structural responses of matter in various optical ranges using spectroscopy and imaging.

Learning outcomes

On successful completion of this course, students should have the skills and knowledge to:

- Understand and master basic knowledge, theories and methods related to material transformations under light exposure; linear and nonlinear interactions, electronic, structural and thermodynamic relaxation paths
- Understand and master basic knowledge, theories and methods related to detection techniques based on spectroscopy and microscopy
- Identify, formulate and solve practical problems related to the use of time-resolved detection systems;
- Critically review and assess scientific literature in the field and apply knowledge to identify the novelty and practicality of proposed methods.
- Design and develop practical and innovative time-resolved investigation techniques.

Content

- Elements of linear and nonlinear optics: light propagation
- Light matter interaction: linear and nonlinear absorption and scattering; models
- Elements of optical spectroscopy
- Elements of vibrational spectroscopy
- Elements of THz spectroscopy
- Elements of mass spectrometry
- Elements of microscopy (optical, electron microscopy)
- Elements of remote sensing
- Time-resolved detection: pump-probe experiments