MATERIALI OTTICI ED OPTOELETTRONICI

CHIM/03 - 6 CFU - 1° Semester

Teaching Staff

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LEARNING OBJECTIVES

Optical and optoelectronic materials have a technological impact in modern life. They include a large selection of materials, developed through an interdisciplinary approach. It can be distinguished two groups of optical materials: molecular materials and bulk materials which, in turn, can be classified in relation to their application in the optical/optoelectronic field. In this course will be presented and discussed the main families of optical materials, in relation to their optical properties, through the study of their crystal and electronic structure. Particular attention will be devoted to their design, synthesis and characterization, in order to optimize their properties and apply them in optoelectronic devices.

In addition, in the frame of the so-called **Dublin Descriptors**, this Course helps attain the following cross-disciplinary competences:

- Knowledge and understanding: Students will develop inductive and deductive reasoning. They will acquire knowledge on and understanding of nature and properties of investigated materials and their strict correlation with functional properties.
- Applying knowledge and understanding: Ability to apply the gained knowledge in order to describe optical and optoelectronic phenomena and material functional properties using rigorously the scientific method.
- Making judgements: Developing critical thinking.
- Communication skills: Ability to orally present, using fluent scientific language and appropriate scientific vocabulary, a scientific topic, including any underlying motivations and illustrating any results.

COURSE STRUCTURE

Frontal lessons.

Should teaching be carried out in mixed mode or remotely, it may be necessary to introduce changes with respect to previous statements, in line with the programme planned and outlined in the syllabus.

DETAILED COURSE CONTENT

1. Linear and nonlinear optical properties of materials: Polarizability and linear optical properties of materials. Birefringent crystals. Principles of nonlinear optics. Nonlinear optical processes. Design and techniques for the synthesis of nonlinear optical materials. Electro-optical materials. Waveguides.

2. Materials for photonic and optoelectronics: Semiconductor materials. The silicon and its optical properties. Direct gap materials. Composite semiconductor materials. Gap dependence from composition. Properties of composite semiconductors: bands' engineering. Ternary and quaternary III-V compounds. Group III nitrides. II-IV semiconductors (CdS, CdSe, CdTe). II-VI semiconductors (HgCdTe). Strained materials: materials' engineering. Amorphous materials: solar cells. Organic semiconductors. Electroluminescent materials.

3. Optical sensors: Chemical sensors based on absorption, fluorescence, or surface plasmonic resonance: techniques and materials. Application of optical sensors in food safety, and in environmental and biomedical fields. Nanosensors.

4. Optoelectronic devices: Light emitting diodes. Semiconductor Lasers. Photodetectors. Organic solar cells.

TEXTBOOK INFORMATION

1. Bibliographic references and handouts in English
2. Slides of lessons: http://studium.unict.it/.
3. J. Singh, "Semiconductor optoelectronics", Mc Graw Hill, 1995.
4. E. Rosencher and B. Vinter, "Optoelectronics", Cambridge University Press, 2002.
5. S. Kasap, P. Capper "Handbook of Electronic and photonic Materials" Springer, 2017.
