UNIVERSITÀ
DEGLI STUDI DI MILANO-BICOCCA

COURSE SYLLABUS

Introduzione alla Scienza e Nanotecnologia dei Materiali

2324-1-ESM01Q027

Aims

To introduce the student to the role that materials science has had in the history of the development of civilizations, from the very beginning up to the present day. Bring the student closer to understanding how important social and technological problems depend on the development and fine-tuning of new advanced materials.

Contents

Part A of the course has the general title "MATERIALS AND THE DEVELOPMENT OF CIVILIZATIONS - Knowing the past to imagine the future"

- applications of materials science in different fields:
- materials in innovative applications for energy
- materials in innovative applications for the environment
- ancient materials and applications in cultural heritage.

Part B of the course has the general title "INNOVATIVE MATERIALS AND APPLICATIONS"

- "How materials science intervenes in the present for a better future"

Detailed program

The general title of Part A of the course is "MATERIALS AND THE DEVELOPMENT OF CIVILIZATIONS - Knowing the past to imagine the future"
The first lesson, "From the Neolithic to Moplen", describes the introduction of the first materials at the beginning of

civilization (ceramics, glass, metals) to then arrive at the materials characterizing the 19th century (steel and concrete) and the development of plastics from second half of the 19th century up to conductive polymers and bioplastics.
The second lesson, "From the invention of paper to the I-phone", is dedicated to showing how new materials are the basis of important revolutions in the field of information technology. Starting from a parallel between the invention of movable type printing and modern information technologies, it traces the history of the development of microelectronics (transistors, integrated circuits) and of the materials and devices that form the basis of the internet, artificial intelligence and computer science data (laser, optical fibers, magnetic media).
The third lesson, "The invisible world", introduces the student to the field of nanotechnology. Some important achievements of the end of the 20th century are described (fullerenes, carbon nanotubes, graphene, STM and AFM microscopy) which are at the basis of the development of nanotechnologies. The prospects for using these technologies for energy and environmental problems and their potential in biology and medicine are discussed.
The fourth lesson, "The environmental challenge", deals with the issue of CO2 and its impact on climate change. The principles of photosynthesis are illustrated, the importance of CO2 in the carbon cycle, the history of how we came to demonstrate the anthropic impact on the planet is retraced, to then illustrate the possible solutions and the role of new materials to produce energy in a sustainable way (solar cell materials), for green hydrogen production (electrolysis), for energy storage (batteries), for CO2 conversion and capture (catalysts and porous materials).

The following two lessons (Part B) will show some traditional and newly developed techniques for applications in the field of Cultural Heritage, often obtained from the development of new materials, such as nanostructured systems for the restoration and conservation of paintings and innovative techniques for the diagnostics of Cultural Heritage, to answer some crucial questions such as provenance, dating or authenticity analysis. Furthermore, techniques aimed at studying the state of conservation of works of art will be presented.

Prerequisites

None

Teaching form

Lesson in classes

Textbook and teaching resource

Slides

Semester

Fist semester

Assessment method

No exam

Office hours

Anytime by appointment

Sustainable Development Goals

AFFORDABLE AND CLEAN ENERGY | RESPONSIBLE CONSUMPTION AND PRODUCTION | CLIMATE ACTION