Nome da disciplina:	Laser micro-processing and surface functionalization
Código:	EMC410220
Carga horária total:	45
Número de créditos:	03
Nível:	Mestrado e Doutorado
Pré-requisito:	
Responsável:	Prof. Dr. Bruno Alexandre Pacheco De Castro Henriques

Ementa:

Chapter 1 - Motivation: Why do we deal with laser precision microfabrication?; Properties of surfaces; Surface structures that can be produced by laser precision microfabrication; Morphology changes induced by laser beams; Surface topography characterization; Bionic prototypes for 2D microstructures; Bionic prototypes for 3D microstructures; Micro- andor nano fabrication methods; Advantages of laser precision microfabrication.

Chapter 2 - Introduction to lasers/types of lasers: Definition of "Laser"; Outline history of the development of the LASER; Fields of Application of Laser Material Processing; Peculiarities of laser radiation; The population inversion; The laser source; Lasers for microprocessing; Operation modes; Parameters defining laser; Calculation of laser parameters; Defining a laser system; Specifications of typical lasers; Overview of laser machining processes; Main components of a laser beam system.

Chapter 3 - Material-light interaction and temperature distribution: Excitation Mechanisms; Thermal and photochemical processes; Absorption, Reflection and Transmission; Reflection of metals; Optical penetration depth in metals; Reflection dependence on polarization and inclination angle; Calculation of light reflection; Optical response in non-metals; Influence of pulse duration on laser ablation process; Interaction of laser light with polymers; Calculation of temperature distributions.

Chapter 4 - Direct Laser Writing and Laser drilling: Direct Laser Writing principle; Focusing of laser beams; Diffraction limit; Aberration limit; Sample scanning techniques; Cartesian axis; 2D-beam deflection; Applications of DLW; Laser drilling methods; Drilling techniques without relative movement between laser spot and workpiece; Single shot (or pulse) drilling; Percussion drilling; Drilling techniques with relative movement between laser spot and workpiece; Trepanning drilling; Helical drilling; Influence of process parameters on drill hole quality.

Chapter 5 - Direct Laser Interference Patterning: Interference methods; Direct Laser Interference Patterning; Principle of DLIP and laboratory setup; Structuring of polymers using ns-DLIP; Structuring of metals; Structuring of conducting polymers thin films; Interference Lithography; Fabrication of 2D, 2,5D and 3D patterns; Fabrication of sub-?m channels; Application examples; Development of DLIP Systems.

Chapter 6 - Two Photon polymerization and stereolithography: basic principle of 2PP; Elements of two-photon polymerization; Lasers for two-photon polymerization; Materials for photopolymerization; Optical configurations for 2PP; The fabrication process; Voxel creation and control; Application examples; Challenges for 2PP in production; Definition and principle of operation in SLA; Modes of operation; Available systems for SLA; Micro- tereolithography;

Applications of SLA and ?SLA; Comparison of ?STL with 2PP.

Chapter 7 - Laser Induced Periodic Surface Structures: Introduction; What are LIPSS?; Types of LIPSS; Analyzing and characterizing LIPSS; Formation mechanism of LIPSS; Applications of LIPSS; Last developments on LIPSS.

Chapter 8 - Polygon scanner processing: Polygon scanning principle; Geometric polygon errors/position accuracy; Principles of polygon scanner micro processing; Factors limiting high-speed laser micro processing; System comparison; Applications of polygon scanners; New concepts for high throughput processing.

Chapter 9 - Laser Safety: Laser-tissue interaction; Absorption of laser radiation by the human; Cooking with laser light; Absorption of laser by the eye; Laser pointers; Summary of absorption by the eye and the skin; Laser exposure limits; Hazard potential of laser equipment; Laser safety goals and industrial realization

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