

MATERIALS ENGINEERING AND NANOTECHNOLOGY (LM56)

(Lecce - Università degli Studi)

Insegnamento NON-FERROUS METALLURGY

GenCod A003984

Insegnamento NON-FERROUS METALLURGY

Insegnamento in inglese NON-FERROUS METALLURGY

Settore disciplinare ING-IND/21

Corso di studi di riferimento MATERIALS ENGINEERING AND

Tipo corso di studi Laurea Magistrale

Crediti 6.0

Ripartizione oraria Ore Attività frontale: 54.0

Per immatricolati nel 2019/2020

Erogato nel 2020/2021

Anno di corso 2

Lingua INGLESE

Percorso PERCORSO COMUNE

Docente PAOLA LEO

Sede Lecce

Periodo Primo Semestre

Tipo esame Orale

Valutazione Voto Finale

Orario dell'insegnamento

<https://easyroom.unisalento.it/Orario>

BREVE DESCRIZIONE DEL CORSO

The course clarifies the microstructure, mechanical properties, processing, physical metallurgy and engineering applications of non ferrous alloys. Particular attention is devoted to microstructure/property relationships and to the role of processing and heat treatments on the microstructure evolutions.

PREREQUISITI

Metallurgy basics

OBIETTIVI FORMATIVI

After the course the student should be able to:

- 1)Identfy the microstructural features, properties and applications of the main non ferrous alloys;
 - 2)Recognize the main microstructural and mechanical features induced by casting, plastic deformation and joining methods;
 - 3)Identify the role of process parameters (welding, casting, plastic deformation) on microstrucural evolution and properties;
 - 4)Apply strengthening methods and heat treatments;
 - 5)Recognize the role of the processing thermal cycle on the microstructure evolution.
- The development of individual projects helps each student to pursue the goals.

METODI DIDATTICI

Lectures, laboratory practice, individual project

MODALITA' D'ESAME

The exam consists of two parts:

1. first written part: the student is asked to illustrate theoretical topics
2. second part: the student is asked to discuss the laboratory topics and individual project with the lecturer.

Lectures:

- 1) A general introduction on the main alloys in terms of the main microstructural features, properties, applications, processing (1h)
- 2) Cristallography, defects, strengthening mechanism (3 hours)
- 3) Metallography and experimental techniques (3 hours):
 - a) Specimen Preparation for Light Microscopy
 - b) Optical microscope
 - c) Hardness test
 - d) EDS
- 4) Physical metallurgy of light alloys:
 - a) Solidification principles: microstructure, heat treatments, defects (8 hours).
 - b) Plastic deformation and solid-solid phase transformation induced by plastic deformation and heat treatments. Recovery and Recrystallization (3 hours).
 - c) Principles of age hardening (6 hours).
 - d) microstructure and mechanical evolution by processing thermal cycle (3hours)Case studies on above topics.
- 5) Aluminum alloys (4 hours)

Wrought aluminum alloy: microstructures and heat treatments, designation of alloys and temper, work hardening, non heat treatable alloys, heat treatable alloys, Joining. Applications.
Case studies on above topics

Cast aluminum alloys: microstructures and heat treatments, designation of alloys and temper, alloys based on the Aluminum-silicon system, alloys based on the Aluminum-copper system, Aluminum-Magnesium alloys, Aluminum- Zinc-Magnesium alloys. Applications.
Case studies on above topics.
- 6) Magnesium Alloys (2 hours)

Microstructures and heat treatments, designation of alloys and temper, Zirconium free casting alloys, Zirconium containing casting alloys. Applications.
Case studies on above topics.
- 7) Titanium alloys (4 hours)

Alpha alloys: microstructure and properties
Alpha/Beta alloys: microstructure and properties
Heat treatments
Joining Applications.
Case studies on above topics.
- 8) New processing for non ferrous alloys: microstructure evolution and properties (9 hours):

New joining techniques: microstructures and properties
New coatings techniques: microstructures and properties
Three dimensional (3D) building process: microstructures and properties
Case studies on above topics.

Laboratory:

- 1) Grinding, polishing, chemical etching, electrolytic etching, optical microscopy analysis, hardness test and tensile test of light alloys: applied to microstructural and mechanical characterization of the following light alloys: 2024, 7075, 6061, A357, C355, Ti-6Al-4V, WE43, AZ91 (4 hours)
- 2) As cast and as welded microstructure characterization of non ferrous alloys both heat and not heat treatable: microstructure, defects, mechanical properties (2 hours)
- 3) Solutionizing and aging heat treatment applied to heat treatable aluminum and magnesium alloys: aging curves at different holding temperatures with or without previous solution heat treatment (2 hours)

4) Deformed microstructure and Recovery and Recrystallization applied to aluminum alloys: microstructure evolution and mechanical properties (2 hours)
5) Homogenization heat treatments (as-cast aluminum alloys) (2 hours): microstructure evolution and mechanical properties
6) Ti-6Al-4V heat treatment (2 hours)
Microstructure evolution and hardness of Ti-6Al-4V due to annealing from Beta phase field.
Microstructure evolution and hardness of Ti-6Al-4V due to annealing from Alpha+Beta phase field
Microstructure evolution and hardness of Ti-6Al-V due to air cooling from Beta phase field.
Microstructure evolution and hardness of Ti-6Al-V due to air cooling from Alpha+Beta phase field.
Microstructure evolution and hardness of Ti-6Al-V due to quenching from Beta phase field.

Individual project

New joining/ coating/ 3D buildings techniques applied to non ferrous alloys: microstructural and mechanical characterization of samples (6-8 hours).

TESTI DI RIFERIMENTO

- [1] American Society for Metals, *Metals Handbook*, V. 15, *Casting*, Metals Park, Ohio, 1988.
- [2] J.D. Verhoeven, *Fundamentals of Physical Metallurgy*, Wiley
- [3] R.W. Hertzberg, *Deformation and Fracture Mechanics of Engineering Materials*, Wiley
- [4] M.Tisza, *Physical Metallurgy for Engineers*, ASM,
- [5] G.E Dieter, *Mechanical Metallurgy*, McGraw-Hill
- [6] I.J.Polmear, *Light Alloys*, BH
- [7] W.F.Smith, *Structure and Properties of Engineering Alloys*, McGraw-Hill
- [7] G. Lutjering, J. C. Williams, *Titanium*, Springer 2nd edition, New York
- [8] R.W. Messler, *Principles of welding*, J.Wiley & Son