MATERIALS ENGINEERING AND NANOTECHNOLOGY (LM56)

(Lecce - Università degli Studi)

Teaching NON-FERROUS METALLURGY

GenCod A003984

Owner professor PAOLA LEO

Teaching in italian NON-FERROUS METALLURGY

Teaching NON-FERROUS METALLURGY

SSD code ING-IND/21

Reference course MATERIALS ENGINEERING AND

Course type Laurea Magistrale

Credits 6.0

Teaching hours Ore-Attivita-frontale: 54.0

For enrolled in 2019/2020

Taught in 2020/2021

Course year 2

Language INGLESE

Curriculum PERCORSO COMUNE

Location Lecce

Semester Primo-Semestre

Exam type Orale

Assessment Voto-Finale

Course timetable https://easyroom.unisalento.it/Orario

BRIEF COURSE DESCRIPTION

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.

REQUIREMENTS

Metallurgy basics

COURSE AIMS

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.

TEACHING METHODOLOGY

Lectures, laboratory practice, individual project

ASSESSMENT TYPE

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.

FULL SYLLABUS

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 tecniques (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 tecniques: 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 (2hours)

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 tecnniques applied to non ferrous alloys: microstructural and mechanical characterization of samples (6-8 hours).

REFERENCE TEXT BOOKS

[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