

### Sistema centralizzato di iscrizione agli esami Programma

2020/21

# Università di Pisa

## ADVANCED CERAMICS AND SMART GLASSES

#### BEATRICE CIONI

Anno accademico

**MATERIALS AND** CdS

NANOTECHNOLOGY

Codice 825II 6

**CFU** 

Ore Moduli Settore/i Tipo ADVANCED CERAMICS **LEZIONI** ING-IND/22 48

AND SMART GLASSES FILIBERTO BITOSSI BEATRICE CIONI

CRISTINA SILIGARDI

GIOVANNI BALDI

Docente/i

#### Programma (contenuti dell'insegnamento)

The course covers the field of advanced ceramics and smart glasses from fundamental science and processing to application. Course Contents:

Ceramic theory: general properties, classification of ceramics (traditional and advanced ceramics), oxides, non-oxides and composites, amorphous and crystalline.

Ceramic microstructures: crystal chemistry, bond energy and properties. Types of imperfections in ceramics, Frenkel and Schottky defects, Kroger-Vink notation.

Ceramic phase diagrams.

Main properties of ceramic materials: porosity, mechanical - thermal, chemical and functional properties. Structure-properties correlations. Durability in ceramic materials: main weathering mechanisms of ceramics, mainly due to freeze-thaw cycles, salts crystallization, thermal cycles, acid attack...

Main characterization techniques for ceramic materials: Optical and electron microscopy, EDS spectroscopy, IR and Raman spectroscopy, Xray diffractometry, mercury intrusion porosimetry, thermogravimetrical analyses, mechanical characterizations.

Raw materials: Silicates (silica, clays, feldspar) and non-silicates raw materials. Characterization of raw materials for ceramics: chemical composition, mineralogical structure, granulometry, rheology, physical and thermal properties.

Ceramic production processes. Mixing, grinding, homogenization, wet and dry processing.

Forming/shaping process: powder pressing, wet molding, casting and extrusion. Sintering: theory and applications.

Advanced Ceramics and ceramic matrix composite: examples and applications (structural, biomedical, aerospace...). Alumina, zirconia, silicon carbide, silicon nitride, hydroxyapatite.

Theoretical and practical explanation of an advanced ceramic production process: Microwave assisted chemical vapour infiltration of silicon carbide composites.

Zirconia based ceramics: introduction what is zirconia, powder production process, aging and solutions, forming methods (die pressing, cold isostatic pressing, hot isostatic pressing, slip casting, extrusion, injection molding, tape casting), heating (dewaxing, pre-sintering, sintering, machining), applications (mechanical, electrical, automotive, medical, energy production, luxury).

Ceramics for biomedical applications: nanomaterials for drug delivery, hybrid nanoparticles.

Smart Glasses: glass materials, properties, characterization, production. Smart glass technologies and applications.

### Modalità d'esame

Oral exam (writing test in some cases).

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