



# UNIVERSITÀ DI PISA

---

## ADVANCED CERAMICS AND SMART GLASSES

### BEATRICE CIONI

Anno accademico	2020/21
CdS	MATERIALS AND NANOTECHNOLOGY
Codice	825II
CFU	6

Moduli	Settore/i	Tipo	Ore	Docente/i
ADVANCED CERAMICS AND SMART GLASSES	ING-IND/22	LEZIONI	48	GIOVANNI BALDI FILIBERTO BITOSSO BEATRICE CIONI CRISTINA SILIGARDI

#### 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, X-ray diffractometry, mercury intrusion porosimetry, thermogravimetric 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).

Ultimo aggiornamento 23/10/2020 09:16