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 BITOSSI 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, 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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