



NAME : ISTECC, INSTITUTE FOR SCIENCE AND TECHNOLOGY OF CERAMICS

INSTITUTION : CNR-NATIONAL RESEARCH COUNCIL

COUNTRY : ITALY

Profile :

ISTECC belongs to the National Research Council and is the Institute playing the most important role in the study of ceramic materials. The main site is located in Faenza and a Unit in Torino.
Total Staff (permanent and temporary) is constituted by 80 persons.

The activities concern the whole range of Ceramic Materials:

Advanced Ceramics, Traditional Ceramics , Cultural Heritage, Materials Machining

Activities :

The activities of the institute are addressed on the three main missions of the National Research Council:

- RESEARCH,
- EDUCATION & TRAINING,
- TECHNOLOGY TRANSFER AND SERVICE TO INDUSTRIES.

The activities are related to research topics financed by CNR and to projects in the frame of European programmes, of contract with Industries, of National and International collaborations.

ISTECC's scientific themes are directed at the fields of:

- Advanced ceramic materials (structural /biomedical/ electrical/electronic applications)
- Traditional ceramics (tiles, tableware, sanitary ware, refractories)
- Cultural heritage (ancient ceramics and mosaics).
- Material machining and surface treatments and analyses

Expertise on following materials :

ADVANCED CERAMICS

CERAMICS FOR STRUCTURAL APPLICATIONS

Oxides: Alumina, zirconia, magnesia, alumina/zirconia composites, alumina/zirconia multilayered materials

Non-oxides: silicon nitride, silicon carbide, boron carbide, titanium nitride, titanium diboride, zirconium diboride, aluminum nitride

UHTCeramics belonging to the systems based on Zr- and Hf- borides and carbides

Structural nanoceramics and nanocomposites : nanosize SiC, Si₃N₄, Al₂O₃-SiC

Structural electroconductive composites based on silicon nitride, silicon carbide, alumina, aluminum nitride, with the addition of secondary phases like titanium nitride titanium boride, molybdenum disilicide, etc.

Cermets (ceramic/metal composite) based on titanium diboride and carbide, titanium carbonitride, tungsten carbide

CERAMICS FOR PROSTHETIC APPLICATIONS

alumina, zirconia, hydroxyapatite and related composites for different prosthesis

CERAMICS FOR BIOMEDICAL DEVICES

Bone fillers, spinal spacers, drug deliveries

CERAMICS FOR ELECTRICAL APPLICATIONS

Piezoceramics (PZT), substrates for electronics, High T_c superconductors,



TRADITIONAL CERAMICS

BUILDING MATERIALS

Structural clay products, wall and floor tiles, sanitary ware, clay pipes.

DOMESTIC WARES

Tablewares, artisan artcrafts.

MATERIALS FOR INDUSTRIAL APPLICATIONS

Refractories, insulators, etc.

Chemical, physical and technological characterization of raw materials and ceramic bodies.

Assesment of technological properties and performance of semi- finished and finished products.

Evaluation of the suitability of raw materials for use in ceramic production.

Appraisal of the possible recycling of wastes and by-products of various industrial manufacturing processes.

Study and optimization of milling-, forming-, drying- and firing-processes for ceramic products.

Development of analysis and testing methodologies on ceramics and pre-standard activity

CULTURAL HERITAGE

CERAMICS AND MOSAICS

Reconstruction of ancient manufacturing techniques finalized to the conservation and restoration and to the reproduction. MAJOLICA: definition of the manufacturing techniques and origins. ARCHAEOLOGICAL FINDS: characterization and definition of the origin. ARCHITECTURAL TERRACOTTA: characterization and processing conditions. MOSAICS: materials, technologies, conservation and restoration. Production of mosaic glasses.

Actual research domains concerning materials technology / Competences :

RESEARCH GROUP ON: Processing and characterization of structural ceramics and composites with functional properties.

RESEARCH GROUP ON: Mechanical and tribological properties of advanced ceramics

RESEARCH GROUP ON: Educational and training and Technology Transfer

RESEARCH GROUP ON: Ceramics and composites for biomedical applications

RESEARCH GROUP ON: Innovation in processing and ceramics for building materials

RESEARCH GROUP ON: Ceramics for electrical/electronic applications

RESEARCH GROUP ON: Ceramics and components for fuel cell applications

RELATIONSHIPS

The Institute is partner of a **Joint Research Institute on Nanoscience (RIN)**, whose partners are ISTEK and Kyoto Institute of Technology and is located in Kyoto

TRAINING -TECHNOLOGY TRANSFER

* Organization and teaching actions of post-doc courses, schools, training courses, seminars.

* Engagement in supervising doctorate and degree thesis, in giving vocational training courses

Besides:



- Involvement in the organization of Meetings and Exhibitions, in the publication of congress proceedings and of monographs,
- Diffusion of scientific and technical information and technology transfer to SME enterprises,
- Actions for consulting, certification, quality control of raw materials and products.

COOPERATION CONTEXT AND OTHER ACTIVITIES

- National and Strategic programmes promoted by CNR and by the Ministry for University and Scientific Research
- European Union programmes
- Italian Universities and Research Institutes belonging to CNR and ENEA
- Foreign Universities and Laboratories (in Europe, Japan, Indonesia, Vietnam, Australia, United States)
- National small and medium enterprises and big industries
- National Commission for standards (UNI)
- International Commissions: CEN, VAMAS
- Museums - Architectural and Environmental Assets Offices
- Medical Structures

Competences and laboratory activities

- *Processes for production of ceramics*

Raw materials: chemical-physical characterization of powders, synthesis of oxide powders (PZT, BISCO, Hydroxyapatite), powder treatments (mixing/addition process), evaluation of the use of new raw materials and reutilization of industrial waste.

Forming: preparation and characterization of specific suspensions and mixes for forming techniques. Rheological characterization of ceramic suspensions and study of the dispersed systems.

Study and optimization of forming techniques (tape casting, extrusion, cold isostatic pressing, die pressing)

Sintering: optimization of processing parameters and techniques, study of chemical/physical phenomena dealing with densification.

Available equipment: furnaces without air pressure and controlled atmosphere up to 2000°C, furnace under gas-pressure and hot isostatic press up to 2200 °C and 200 Mpa, hot press

Joining: study of processes for ceramic/ceramic and metal/ceramic joinings

Coating: processes of screen printing and of sputtering

Production of prototypes: complex shaped components for specific applications

- *Characterizations*

Microstructural, morphological, textural and chemical characterizations: optical and electronic scanning microscopy, microprobe, X-Ray diffractometry, Rt and X-Ray fluorescence, ICP spectrometry ICP-AES, X-Ray sediment, porosimeter, thermal analysis (TG-DTA and dilatometry);

Rheological and electrospherical characterization for which the principal instruments are: viscosimeter, torsion rheometer, acoustosizer;

Measures of electrical characteristics and of mechanical, hardness, toughness, strength, fatigue and tribological properties;

Study of thermal physical properties.

Available research infrastructure :

At ISTECC the following equipment for processing (powder treatment, forming, sintering) and characterization (microstructure, mechanical and functional properties) is present:

- Tools for powder mixture preparation
- Ultrasonic apparatus
- Freeze dryer
- Rotary evaporator
- Die presses
- Cold isostatic pressing



European Network of Materials Research Centres

- Equipment for screen printing
- Tape casting equipment
- Set of sintering furnaces in air up to 1700°C
- Sintering furnace for temperatures up to 2000°C, under controlled atmosphere
- Hot pressing equipment, max T=1900°C, max P=30 MPa, vacuum atmosphere
- Gas pressure sintering furnace up to 2200°C, 10 MPa, nitrogen or argon
- Thermogravimetric and differential thermal analysis up to 1600 °C , Netzsch, under air or controlled atmosphere
- Dilatometer up to 1600 °C (Netzsch)
- Scanning electron microscope (Cambridge 360)
- Energy-dispersive microprobe analysis (EDX Link)
- Equipments and materials for metallographic and ceramographic preparation
- X-ray diffractometer (Rigaku, Philips)
- XRF Spectrometer
- ICP Spectrophotometer
- Equipment for the measurement of the specific surface area
- Porosimeter
- Acoustosizer
- Viscosimeters
- Microindenter (Zwich)
- Nanoindenter
- Equipment for flexural strength measurement at room temperature and at high temperature up to 1500°C
- Equipment for tribological characterization
- Equipments for electrical characterization

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