CALL FOR PAPERS Abstract Deadline - October 15, 2021

Montecatini Terme - Italy - June 20-29/2022

15th International Ceramics Congress June 20-24/2022

Celebrating

IMTE

AR

9th Forum on New Materials June 25-29/2022

Invitation to Attend!

CIMTEC 2022 - 15th International Conference on Modern Materials and Technologies - will be held in Montecatini Terme, Italy, June 20 to 29, 2022. It will feature the 15th International Ceramics Congress (June 20-24) and the 9th Forum on New Materials (June 25-29), each of them including a number of international Symposia and Conferences. As a major longstanding event for the international materials community, CIMTEC will gather together a large and qualified audience of materials scientists, physicists, chemists and of experts of a wide range of the most demanding application engineering areas of modern materials, from the molecular and nanoscales to large complex integrated systems.

The Chair, Co-Chairs and CIMTEC 2022 Committees Members invite you to foster the progress in the field by contributing with your expertise to what promises to be a very comprehensive and exciting event, and to enjoy the immense unique artistic heritage and wonderful landscape of Tuscany.

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CIMTEC 2022 Montecatini Terme, June 20-29, 2022

15th International Ceramics Congress June 20-24, 2022

9th Forum on New Materials June 25-29, 2022

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Symposium CA Advances in Processing Science and Manufacturing of High Performance Ceramics and Composites

This symposium will highlight recent progress in the processing science and manufacturing of advanced ceramics and composites. Covered are the conventional powder processing routes, and emerging unconventional or novel techniques capable of embodying ceramic materials with unique properties not possible or difficult to be achieved with traditional methods; approaches that may also conceive simplified and/or environmentally benign and energy saving "green" processing cycles. Interest is for dense and porous bulk materials, (nano)particle reinforced/functionalized composites, thick and thin films, laminated and graded structures, hybrid and hierarchical nanostructures. Rational improvements of the conventional methods of powder synthesis, processing and sintering; mechanisms and kinetics involved by novel fabrication techniques; new directions and challenges for the design at atomic/molecular scale of complex high performing, micro-, meso- and macro-structures with optimized properties for desired performance; developments in theory, simulations and testing will be focus areas of interest for this symposium.

Session Topics

CA-1 Advances in conventional powder processing routes

- Powder synthesis and characterization(solid state, solution processes, sol-gel, hydrothermal, combustion synthesis, mechanosynthesis, laser/microwave/plasma assisted synthesis...; structure, chemistry, morphology, state of aggregation, packing, flowability, sinterability, ...)
- Colloidal processing (surface chemistry, rheology, agglomerate softening/removal, new surfactant/ dispersant systems...)
- Shape forming and green body processing and characterization (pressing, injection moulding, slip/tape casting, plastic forming, freeze and gel casting, additive free forming, large/ complex shape components, debinding processes, computer-aided processing, modelling and simulation of forming processes...)
- Sintering and related processes (free and constrained sintering, pressure assisted, atmosphere-controlled sintering, interface phenomena, simulation of sintering and interface dynamics, nano/microstructure control, structure/property relationships...)
- Innovations in manufacturing (novel approaches for energy efficiency and environmental compatibility, transitions from laboratory to factory, case studies of industrial practice)

CA-2 Solution-based processing of functional materials

(nanoparticles, fibres, thin/thick films, membranes, aerogels; nanocomposites, hybrid structures, structural and functional characterization in view of specific applications)

CA-3 Polymer-derived ceramics

(novel preceramic polymers systems, conversion mechanisms, innovative processing for precursor-derived ceramics, composites, hybrid materials, fibres, coatings, foams; structural and functional characterization, modelling of materials, processes and functions)

CA-4 Microwave processing

(microwave-material interactions, temperature control during processing, non-contact temperature sensing, microwave assisted synthesis, melting, coating, joining, theory and modelling of processes, hybrid processes, scaleup, structural and functional characterization of materials)

CA-5 Novel sintering approaches - Spark Plasma, Flash Sintering, Cold Sintering, Laser Sintering

(mechanisms and control of SPS, FS and CS, modelling and simulation of electrical field and flash-activated densification, hybrid techniques, sintering dynamics, pressure and solvent effects, phase constitution and crystallization, materials properties...)

CA-6 Additive manufacturing

(laser-based processes, LOM, fused deposition modelling, stereolithography, direct writing....; multimaterial processing, 4D printing...)

CA-7 Other special processing routes

(ultra-high pressure and shock synthesis and compaction, microgravitational processing, directional solidification from eutectics, controlled crystallization from undercooled glasses i.e. the glass ceramic route.....)

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Focused Session CA-9 Bio-inspired and Bio-enabled Processing

Complex multifunctional nano structured materials with peculiar and specially designed electrical, magnetic, electro chemical, bioresponsive and structural properties resulting from bio inspired processing routes are stimulating growing research as they involve such diverse areas as molecular recognition and self assembly, self healing, hierarchical patterning, biotemplating and microorganisms-mediated materials synthesis.

Covered by this Session, that follows the ones on the same topics held in previous CIMTEC Conferences, will cover matter related to the biomolecular-directed growth and microstructure pattern formation of ceramic and metal meso/nanostructures in bulk and thick/thin film, organic-ceramic composites and hybrids, and ceramic-metal heterostructures provided with special functionalities for a number of potential applications in, e.g., high performance light-weight structures, efficient biosensing materials and catalysts, improved biomedical materials with stimuli-adaptive, self-assembly and self-repairing properties and in electronic, optical and photonic devices.

Session Topics

Self-assembly, mineralization and hierarchical organization

Hybrid structures and living materials

Structure and mechanics of bioinspired materials

Bioinspired functional surfaces

Bioinspired materials for biomedical applications

Application and performance of bioinspired materials

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Focused Session CA-10 Functionally Inorganic Graded Materials

Functionally graded materials embody continuous spatial variation in composition and microstructure purposedly designed to tailor their mechanical, thermal, electrical, optical and biological properties.

Various approaches based on e.g. particulate processing, layer processing, energy, beams, diffusion processes, additive manufacturing etc are used to obtain functionally graded materials possessing passive, active and multifunctional capabilities suitable for a wide range of civil, industrial, automotive, energy, aerospace and medical applications.

This Focused Session will discuss aspect related to design, processing and characterization of the wide range of inorganic FGMs including their performance, reliability and life cycle during use.

Session Topics

Design criteria synthesis and processing of FGM bulk materials, composites and hybrids

Functionally graded thin films and coatings

Characterization, structure and functionality

FGMs for mechanical and thermochemical applications

FGMs for functional and multifunctional applications

Modelling and simulation of materials and processes

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Focused Session CA-11 SHS Ceramics

The remarkable improvements in the SHS process underwent within the last several years have expanded substantially the field of application of SHS as an effective, simple, lowcost method for the production of various industrially useful ceramics. A variety of high performing nanopowders and (multi)layered nanostructures of nitrides, carbides, cermets and complex mixed oxides is to day being produced and exploited in such diverse field as metal working, biomedical implants, solid state lighting, catalytic systems as well as in advanced functional devices. Aim of this Focused Session, following those on the same subject held in previous CIMTEC Conferences, is to overview recent achievements in the theory and modelling of the self-combustion process, in the design, processing and applications of SHS ceramic-based material and enlighten perspectives for a more effective penetration of the SHS technology in the industry.

Session Topics

- CA-11.1 Theory and modeling of SHS processes and structural transformations
- CA-11.2 SHS of powders from the micro- to nano-scale. Consolidation of the SHS-powders (sintering, HP, SPS, HIP, etc.)
- CA-11.3 SHS of bulk materials (functional and structural ceramics, composites, metal/ceramic composites, foams...)
- CA-11.4 Application and industrialization

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Focused Session CA-12 Ceramic Joining: From Macro- to Nano-length Scales

The demand for new applications for ceramics joints at different length scales, i.e. from nano/ micro-mechanical systems to large components is still growing and requires specialised joining solutions to meet complex end-product requirements. Challenges arise when components of differing materials with often incompatible behaviour must be joined and integrated in operating systems. This session, that follows the ones on the same subject held in previous CIMTEC Conferences, will discuss fundamental and practical issues of the joining of inorganic materials (i.e. ceramic-to-ceramic/-glass-metal-carbon), at different length scales. Experimental and theoretical viewpoints will be addressed concerning physical chemistry of surfaces and interfaces: wetting and interfacial reactions; diffusion and compound formation; joining techniques; joint characterization and testing; lifetime and reliability prediction of joints, and their in-service performance.

Session Topics

- CA-12.1 Nano-scale interface of dissimilar materials and micro-/ nano-joining
- Interface science for integration of inorganic materials.
- (Nano-)Thermodynamics and kinetics of interface formation
- Mechanisms of wetting and adhesion
- Characterisation and control of interfaces for high quality joints
- Mechanisms and materials science of micro-/nano-joining - Nanoscale effects
- Micro-/nano-joining techniques
- Development of nanostructured joining materials

CA-12.2 Macro-joining and application engineering

- Advances in joining methods and materials, 3D-printing and Additive Layer manufacturing applied to joining
- Joints of dissimilar materials
 - Prediction, measurement and control of residual stresses
 Joint behaviour (strength, thermal and chemical stability,
 - reliability...) - Joint modelling, design, characterisation and analysis
 - Joining and integration issues at the macro-, micro- and nanoscales in diverse areas
 - Joining of nanostructures and their integration into devices and systems
 - Joining techniques for microelectromechanical systems and microelectronic packaging
 - Space, automotive, energy, biomedical and other ongoing or forecast applications

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Symposium CB

Big Data and Machine Learning Methods for Materials Advancements

The traditional way of innovations and development in materials field are human-centred, where scientists and engineers design, conduct, analyse and interpret results obtained through simulations, experiments, or literature review. Such results are often high-dimensional, huge in number and heterogeneous in nature, which hinders researcher's capability to draw insight from extensive information. As we approach the new era of explosive generation of big data and creative concept of artificial intelligence and machine learning, we may envisage a completely different paradigm for generating knowledge and advancing technology. Machine-aided innovation will accelerate important leaps towards better and more affordable solutions for the sustainable development of human society. Big data enhanced emerging technologies would be able to pioneer the new paradigm to discover truth beyond information and generate knowledge.

This Symposium, endorsed by the World Academy of Ceramics, features two sessions. The first one would address virtual materials design, integration of information technology and the next-generation manufacturing. The technical program will identify key challenges and opportunities for big data enhanced technologies in accelerating materials innovation and creating sustainable development. Some of the key topics which will be covered are high throughput materials design and characterization, artificial intelligence aided smart manufacturing, and other information enhanced emerging technologies for sustainable advancements of ceramic materials.

Quantification of microstructure by data analysis and machine learning methods will be of specific interest for the second session. Indeed, Central to materials science are the links between processing and microstructure, and between microstructure and properties. Advances made in recent years include the ability to image microstructures over large areas with high resolution using multiple electron beams that raster simultaneously in SEM and obtaining high resolution 3D images using tomography or reconstruction methods. Developing methods to quantify size, shape, curvature, texture, distributions of these quantities, topology, connectivity, and spatial correlations between such characteristics of microstructure features would greatly enhance our ability to design and fabricate ceramics microstructures to optimize properties.

The overall symposium is expected to generate interest and discussion on how the ceramic community might facing the challenges of sustainable development and industry 4.0.

Contributions are welcome in each of the following Session Topics:

CB-1 Big data emerging technologies for innovative materials design and manufacturing

- Virtual Materials Design and Evaluation
- High-throughput Characterization and Testing
- Big Data Methodologies and Integration of Information Technology
- Machine Learning and Artificial Intelligence
- Smart Manufacturing

CB-2 Quantification of materials characterization by data analysis and machine learning methods

- Automation of stereological techniques to characterize microstructure
- Data analysis for quantitative description of microstructure - Machine learning to recognize microstructural features
- and quantify microstructures
- Development of long-range descriptors
- Application of data analytics or machine learning to find processing-microstructure or microstructure-property relationships

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Symposium CC Modelling, Simulation and Testing of Mechanical and Thermomechanical Properties of Bulk Ceramics, Coatings and Composites

Owing to their outstanding structural properties and performance, ceramic materials have been applied in a large number of engineering fields at all temperature regimes and environments, including e.g. transportation, space, energy generation, microelectronics, optical systems, armour, and clinical uses. A great amount of research work has been performed for decades to limit the effect of their intrinsic brittleness and to understand the deformation and failure modes. In addition, more recent substantial advances to learn, control, and design ceramics at the nanoscale have been achieved, but the long-term mechanical reliability remains a critical issue for successful application in specific demanding applications. This symposium aims to address recent achievements on correlations between micro (nano) structure and the effects of application environments on the mechanical/thermomechanical behaviour of bulk ceramics including graded structures, ceramic matrix and metal matrix composites, and thin and thick film coatings. Advanced analytical and computational tools to establish constitutive models for complex loading conditions, in-situ studies and non-destructive testing, and newly alternative approaches for characterization will be relevant topics for discussions among the several aspects critical for understanding and determining ceramics mechanical performance and longterm reliability.

Main proposed topics for discussions:

- Failure analysis (strength, creep, slow crack growth, fatigue)
- Elastic properties
- Hardness, toughness, stiffness
- Friction, wear
- Contact damage, ballistic impact, thermal shock
- Mechanical stress/thermal tress analyses
- Nanomechanics
- Plastic deformation of nanostructured materials
- Deformation-induced phase transformations
- Microstructure and mechanical/thermomechanical properties relationships
- Mechanical and thermomechanical characterization techniques
- Micromechanical and in-situ testing
- Non-destructive testing
- Theory and modelling/quantum mechanics/molecular dynamics/finite element methods
- Life prediction and design criteria for structural ceramic components
- Mechanical testing of joined and integrated components and structures

Session Topics

- CC-1 Bulk (dense/porous) ceramic materials and components
- CC-2 Thick coating, thin films, graded materials
- CC-3 Particulate, fibre, nanomaterial reinforced CMCs and MMCs, including laminated and sandwich structures

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Symposium CD

High and Ultra High Temperature Ceramics and Composites for Extreme Environments

Revolutionary improvements in operating efficiency or performance characteristics require increasingly hostile operating environments. For example, handling of molten metals exposes materials to extreme temperatures, reducing conditions, and thermal shock. Other applications of interest include leading edges for hypersonic aerospace vehicles, flow-path components for advanced aerospace propulsion systems, refractories for steel, glass, and specialty metal processing, and many others. Ceramic materials and ceramic matrix composites are candidates for many applications that involve severe temperatures, chemical reactivity, or mechanical stresses.

In recent years, a number of oxide and non-oxide ceramic materials have been investigated for use in extreme environments. This symposium will examine the critical



aspects in four different areas: 1) Synthesis and Processing; 2) Corrosion, Oxidation, and Testing; 3) Mechanical and Thermal Properties; and 4) Characterization, Analysis, and Simulation. The materials of interest comprise a wide range of ceramics including conventional oxide ceramics such as alumina and zirconia to more specialized compositions such as boride, carbide, and nitride materials. The materials of interest can be monolithic, single phase ceramics, porous materials, multi-phase particulate ceramics, or composites. Ternary carbide materials (i.e., the MAX phases) are the subject of a separate symposium and are excluded from this one.

Session Topics

CD-1 Synthesis and processing

New materials and novel synthesis routes Production of nano-powders, coatings, and engineered architectures

- Carbothermal and borothermal reduction
- Polymer derived ceramics and solution synthesis routes
- In-situ reaction synthesis

Shape forming methods such as pressing, tape casting, extrusion, etc.

- Additive manufacturing and net shape forming Densification kinetics
- Pressureless and pressure-assisted sintering
- Field assisted sintering and other advanced methods Directionally solidified eutectics
- Ultra-high temperature ceramic matrix composite

CD-2 Corrosion, oxidation, and testing

Analysis of reaction mechanisms and kinetics Testing in simulated hypersonic flight conditions or other operational environments Highly energetic reaction environments Correlation of laboratory testing to application environments

Simulation and modelling of degradation reactions Phase equilibria and thermodynamic tools Non-equilibrium reaction analysis

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CD-3 Mechanical, thermal and optical properties

Strength and fracture toughness

- Friction and wear Elevated temperature properties
- Testing above 1600 °C
- Finite element simulations and other models
- Testing under combined loads (e.g., mechanical and elec-
- trical)
- New test methods
- Microstructure-property relationships

CD-4 Characterization, analysis, and simulation

Advanced characterization methods In-situ and in-operando characterization under extreme conditions Electron microscopy and high resolution imaging Emerging characterization tools for structural materials Spectroscopic methods Thermodynamic and kinetic studies Ab-initio calculations and other predictive tools First principles simulations Experimental and computational studies of phase equilibria Multiscale simulations and models

Symposium CE Progress in Nanolaminated Ternary Carbides, Nitrides and Borides (MAX/ MAB) Phases and Derivatives Thereof (MXenes)

This Symposium aims at being an international forum in which the different aspects of the MAX phases and other layered carbides and nitrides and their 2D derivative compounds, viz. the MXenes, are discussed. The MAX phases are layered hexagonal machinable ternary early transition metal carbides and nitrides. Currently the MAX phases number over 70, with new ones, especially 413's and solid solutions still being discovered on a routine basis. The recent discovery of out of plane ordering, (o-MAX) and inplane ordering (i-MAX) phases and their 2D derivative have greatly enriched and invigorated the field. The re-discovery of layered transition metal borides (MAB) phases that share some, but not all, similarities with the MAX phases is also a new and exciting.

The International Symposium "Progress in Nano-laminated Ternary Carbides, Nitrides and Borides (MAX/MAB) Phases and Derivatives Thereof (MXenes)" will focus on the latest advances in understanding the chemistry/processing/ properties/microstructure relationships in the MAX/MAB and MXene phases. The proposed sessions will cover the gamut from density functional theory calculations to transport properties, to new phases, both predicted and synthesized, to ambient and high temperature mechanical properties, including creep and oxidation. How the MAX phases are converted to MXene and the properties of the



latter will also be covered. Lastly, a session will be devoted to current and potential applications of these novel, exciting and unusual phases.

Session Topics

- CE-1 New MAX/MAB/MXenes
- CE-2 Synthesis and fabrication of MAX/MAB/MXenes
- CE-3 Mechanical and oxidation properties of the MAX/ MAB/MXenes
- CE-4 MAX/MAB and MXene composites and their properties
- CE-5 *ab initio* calculations, electronic and magnetic properties
- **CE-6 Functional properties of MAX/MAB/MXenes**
- CE-7 Applications of the MAX/MAB and MXene phases

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Symposium CF Advances in Functional Materials for Energy Harvesting, Storage and Solar Fuels

Functional nanomaterials with intrinsically new and tailored properties are key elements for developing sustainable solutions for energy, environment and health. Specifically, this symposium will focus on new energy technologies and devices based on inorganic, hybrid and composite materials. This symposium will focus on the multifunctional materials and techniques that offer advanced processing, improved properties, and low-cost/low-temperature synthesis, with a strong focus on the recent innovation in nanotechnological approaches and the assessment of their industrial impact. Particular emphasis will be given to novel synthesis approaches, surface functionalization, and heterostructuring of nanoparticles, nanowires, and nanoscopic films and their heterostructures, fundamentally new properties, and energy-efficient materials synthesis. Applications of nanostructures in photocatalysis, photovoltaic, energy, sensing and bio-medical applications that combine advanced processing with conceptual advancement will form the major thrust areas. Contributions related to energy applications such as perovskite materials, batteries, fuel cells, water splitting, and carbon dioxide conversion as well as transparent conductors and challenges related to the large-scale production and integration of functional and structural nanomaterials are highly desired.



This event will provide an international forum for the presentation of technological advances, and latest research on the state-of-the-art in innovative processing and device applications of new materials to meet the challenges of sustainable energy and environment technologies. Interested and committed individuals from academia, national laboratories, industries and start-up companies are invited to contribute by submitting their abstracts on the following and related topics.



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Session Topics

CF-1 Innovative processing of nano- and heterostructured functional materials

- Chemical processing of nanomaterials: electrospinning, plasma-assisted chemical vapor deposition, atomic layer deposition and microwave-enhanced synthesis, sol-gel, and chemical solution techniques
- Atom- and energy-efficient processing of advanced nanomaterials and nanocomposites
- Innovative techniques for characterization and manipulation of nanostructures
- Fabrication of interface-driven functionalities and multimaterial heterostructures
- Synthesis, functionalization and assembly of nanomaterials and nanocomposites
- Scaled-up production of nanomaterials

CF-2 Functional metal oxide nano- and heterostructures for photovoltaics and solar fuels

- Metal oxides nanomaterials for artificial photosynthesis
- Molecular and semiconductor catalytic materials and systems for CO2 reduction
- Transparent conducting oxides and heterostructures for energy harvesting
- Nanostructured oxide and nanocomposites for excitonic solar cells
- Anisotropic metal oxide nanostructures for photovoltaics
- Piezoelectric nanostructures for self-powered systems
- Heterostructures for plasmonic energy transfer
- Nanodevices: fabrication and large-scale integration

CF-3 Recent developments in photovoltaic materials

- Advanced materials for next generation photovoltaic devices
- Frontiers of organic, hybrid, and perovskite solar cells
- Solar cell architectures and materials requirements
- Next generation electron and hole transport materials
- Hybrid interfaces and nanocrystalline junctions
- Charge generation, trapping and transport
- Optoelectronic devices based on nanoparticle, nanowires and composites

Symposium CG Ceramic Thin Films and Coatings for Protective, Tribological and Multifunctional Applications

This symposium focuses on cutting edge experimental, theoretical and manufacturing issues associated with advanced thin films and coatings deposition techniques and surface modification and functionalization processes. These processes allow the realisation of surfaces with enhanced properties and/or novel multi-functionality, thereby enabling them to meet present requirements and future challenges for more efficient, reliable, inexpensive and clean applications that serve the technological needs of our society. Of interest are materials systems based on oxide and non-oxide ceramics; new carbons; metal-ceramic, organic-ceramic and nano-composites; and hybrid and graded structures.

Focus will be on:

- Advances in deposition, surface modification and nanostructuring techniques
- Refined characterisation and properties at meso- to nanoscale
- Protective coatings aimed at improving the often combined, thermal, chemical and mechanical degradation of components in corroding, oxidizing and generally harsh environments.
- Thermal and Environmental barrier coatings (TBCs and EBCs) to increase the operating temperature of static and dynamic components in advanced gas turbines and in a number of other high temperature applications

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- State-of-the-art tribological thin films and coatings used in, for example, cutting tool and machining, medical devices, electronic displays, hard disks, optical coatings etc.
- Smart and multifunctional thin films and coatings: self-cleaning, anti- microbial, anti-fouling, catalytic, electrically/magnetically/optically stimuli-responsive etc.
- Multiscale materials and process modeling and simulation; data-base development for coatings

Session Topics

- CG-1 Thin film deposision
- CG-2 Thin film attributes
- CG-3 Thick film, suspension spray and tribology
- CG-4 Thermal and environmental barrier coatings





Symposium CH

Porous Ceramics for Environmental Protection, Energyrelated Technologies and Advanced Industrial Cycles

The focus of this Symposium is to discuss innovative approaches to develop, characterize and apply ceramics containing a high volume of tailored porosity, ranging in size from Angstroms to millimeters.

These porous ceramics include high surface and cellular architectures such as honeycombs, foams, scaffolds, hollow fibers, fiber networks, membranes, nano-, micro- and meso-porous materials, monoliths and coatings possessing hierarchical porosity, as well as structures produced by the replication of biological templates or by additive manufacturing technologies. Such porous components find use in a wide range of emerging applications in environmental protection, water purification, energy production and saving, molecular scale sensing, optical devices and a number of advanced industrial applications.

The main topics that will be addressed are:

- New materials and synthesis mechanisms
- Materials optimization at the nano- and meso-scale
- Theory and experimental evaluation of physical and chemical processes related to material functions such as transport phenomena, defect chemistry, interface reactions, separation and catalysis mechanisms, etc...
- Novel design and fabrication of components and devices
- Evaluation of material/component/ device performance
- Advances in testing methods
- Modeling of structure and properties of porous ceramics
- Topological optimization of porous ceramic components
- Engineering applications of porous ceramics

Session Topics

- CH-1 Novel processing and synthesis of porous ceramics (nano to macro), including Additive Manufacturing
- CH-2 Adsorption, capillary phenomena, molecular thermodynamics of fluids and intermolecular interactions within the porous network



CH-3 Structure and functional, mechanical and thermal properties of porous ceramics; structure/transport/ functional properties relationships

CH-4 Advances in the characterization of the porous structure

(adsorption and intrusion porosimetry, thermophotometry, high resolution microscopy, image analysis, scattering techniques, computed tomography, etc.)

CH-5 Modeling and simulation of porous structure and properties

CH-6 Applications of porous ceramics

- gas filtration and separation
 micro filtration and ultrafiltration
- catalysis and catalyst supports
- membrane reactors
- functional applications
- energy applications - advanced industrial applications

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Symposium CI Progress in Electroceramics Research

Improvements in basic knowledge and practical exploitation of their unique properties, has established electrical ceramics as a central and fast developing sector in materials research, resulting in a significant impact on several areas of modern technologies. The increasing demand for even more refined or novel properties hardly to be competitively

met by other materials is fuelling the interest for improved or new processing routes and deeper understanding of the fundamental materials science to meet requirements coming from a variety of advanced civilian and defence applications.

Materials with unusually high dielectric constant, with low loss and low temperature resonance coefficient at very high frequencies, lead-free piezoelectrics, multifunctional materials such as multiferroic heterostructures and ionic and mixed ionic electronic conducting ceramics are but some examples of the ongoing developments in the area which massively makes use of the opportunities offered by nanoscience and nanotechnology, and by computational modelling and new theory.

Major focus will be on:

- Development of new and more efficient processes, better characterisation tools of bulk, crystalline, glassy and amorphous materials, thin films, multilayers, superlattices, nanomaterials, nanostructures and hybrid materials; advances in thin-film and related micro/ nano-fabrication techniques and "bottom-up" approaches that offer the potential for high-density integration of nanoscale devices
- Fundamental mechanisms, novel (multi)functional characteristics and behaviour of materials such as electronic structure, quantum effects, phase transitions, transport phenomena, defects, diffusion, domain structure and switching, grain boundary controlled mechanisms, nanosize effects, surfaces and interfaces, dielectric, piezoelectric, magnetic and optical properties, ageing and fatigue, reliability, fractals, modeling and simulation, etc.
- New developments in devices including fuel cells, batteries, high energy density capacitors, gas separation membranes, tunable dielectrics for microwave applications, piezoelectric composites, sensors and actuators, MEMS/ NEMS devices, and related integration technologies.

Session topics

CI-1 Dielectrics and microwave materials

- Fundamentals, synthesis, processing, characterisation - Capacitor dielectrics
- Mott insulators
- Microwave and millimeter wave dielectrics
- Tunable dielectrics
- LTCC
- New thin film materials and integration technologies
- Packaging and interconnect issues

CI-2 Ferroelectric, piezoelectric, pyroelectric, and ferroelastic ceramics

- Synthesis and processing: polycrystalline ceramics and composites, thin/thick films, single crystals, novel materials
- Lead-free ferroelectrics and piezoelectrics
- Relaxor ferroelectrics
- Theory and modelling
- Characterisation
- Electromechanical behaviour and piezoelectric applications
- Thin film devices
- Capacitor applications, MLCC
- Sensor applications
- Novel applications

CI-3 Multiferroics and magnetoelectric ceramics

- Theory and modeling of single phase and composite multiferroics
- Non-oxide, organic-inorganic and 5-d oxide multiferroics



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- Advances in materials synthesis and processing
- Magnetoelectric characterization and electric field control of magnetization
- Domain walls and dynamics of multiferroics
- New effects
- Devices and applications

- CI-4 Semiconducting and fast ion-conducting ceramics Amorphous and crystalline semiconducting and fast conducting oxides
 - Non-oxide semiconductors and fast ion conductors
 - Synthesis, processing, characterisation
 - Defect chemistry, doping mechanisms, carriers origin and dynamics
 - Devices and applications

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Symposium CJ **Materials Demands Towards Next** Generation **Electrochemical Energy Storage** Systems

The potential of electrochemical energy storage in batteries and supercapacitors is enormous, ranging from small sizes for mobile electronics to medium sizes for transportation to large sizes for electric grid storage. Electrochemical energy storage is also the most appealing option for the effective utilization and implementation of renewable energy sources, such as solar and wind to establish a cleaner environment.

Understanding, controlling, and predicting the structure and properties of solids and the development of new materials with novel synthesis approaches and enhanced properties have driven the energy storage field for the past three decades. Although the performance level and cost of the current generation of storage devices are acceptable for mobile applications, novel intuitive concepts are needed for next-generation of high-performing electrochemical energy storage systems at an affordable cost with improved safety to penetrate the major new markets.

Design and synthesis of new electrode and electrolyte materials, advanced characterization methodologies including in situ techniques to understand at the atomic and nanoscale the surface, bulk, and interfacial characteristics, and computational analysis to predict materials behaviours and guide the design of new materials are among the main challenges for developing new next generation of highperformance materials.

This Symposium will emphasise breakthroughs in materials and energy storage systems for practical implementation. The Symposium will cover advances in electrode and electrolyte materials for rechargeable batteries, including new cell chemistries, novel electrode architectures, in situ and ex situ characterization, advanced computational methodologies, new cell configurations, and system development, along with addressing reliability, lifetime, cost, safety, and environmental issues for practical implementation.

Session Topics

CJ-1 Batteries

- Rechargeable batteries: anodes, cathodes, and electrolytes - Cell chemistries: Li-ion, Li-S, Li-air, Na-ion, Mg-ion, Al-ion, all solid-state, redox flow, etc.
- Bulk, surface, and interfacial characterizations
- Computational modeling
- Cell design
- Application engineering

CJ-2 Supercapacitors

- Supercapacitors
- Pseudocapacitors and hybrid devices
- Electrodes and electrolytes
- Cell design



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Symposium CK Solid Oxide Fuel Cells: Materials and Technology Challenges

Solid oxide fuel cells (SOFCs) are advanced and sustainable energy technologies to address fuel conversion, energy efficiency, polluting emissions and related effects on global warming and climate changes. SOFCs deliver electrical energy at high efficiency by consuming different type of fuels including hydrogen, hydrocarbons, alcohols etc. that are supplied on-demand to the cell. SOFC technology fed with sustainable fuels such as "green" hydrogen and biofuels can thus contribute to achieve the targets concerning with reduction of greenhouse gases emissions, increase of renewable power sources and energy efficiency. These technologies comply with the requirement of a low carbon economy by 2050. Solid oxide fuel cells are solid-state electrochemical devices based on ceramic materials that provide superior solution for several applications including distributed generation of electrical energy in combined heat and power systems as well as for transportation. In particular, they offer an efficient solution for energy applications in residential and integrated industrial systems, and as auxiliary power units in transportation. New frontiers in this field deal with protonic systems, direct oxidation of organic fuels, advanced fuel processing of high molecular weight hydrocarbons, additive manufacturing-3D printing etc.

The International Symposium on "Solid Oxide Fuel Cells: Materials and Technology Challenges", aims to collect all innovative contributes in the area of Solid Oxide Cells based devices boosting a renewed propensity towards more realistic applications and an increased social acceptance of these technologies. This symposium will focus on major advances in materials science, modeling, processing, stack manufacturing and system development for solid oxide ceramic fuel cells.

Original papers are solicited on different types of solid oxide fuel cells. Of particular interest are recent developments of advanced materials, novel stack designs, emerging cell technologies, solid oxide fuel cell applications, optimization and breakthroughs in performance. Reviews of the stateof-the-art solid oxide fuel cell performance for specific applications, including consumer devices, electric vehicles, and distributed energy systems, may also be submitted.

Session Topics

- CK-1 High temperature solid oxide fuel cells Materials and processes, fuel processing, mechanical and thermal properties
- **CK-2** Intermediate temperature solid oxide fuel cells Oxygen ion, proton and mixed conductors, surface and interface reactions
- CK-3 New frontiers in solid oxide fuel cell Direct oxidation of organic fuels and carbon, reversible solidoxide fuel cells, additive manufacturing-3D printing
- CK-4 SOFC cells, stack design, system demonstration and application Electrochemical performance, reliability, degradability, fuel versatility
- CK-5 Modelling of SOFC materials, processes and devices

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Symposium CL

Inorganic Materials Systems for Advanced **Photonics**

The fruitful exploitation of optical ceramics and glasses and related photonic structures and devices as crucial pivots for the development of several enabling technologies provides a large spectrum of functionalities that allow us to face successfully socio- economic challenges in many fields going from energy production and saving to efficient and clean industrial cycles, from environmental protection to fast efficient novel communication systems, from structural monitoring to quantum technologies and to healthcare applications.

This Symposium, that follows the several ones on similar subject held at previous CIMTEC conferences, is to provide latest insights on fabrication, characterization and exploitation of photonic structures based on ceramics (oxides, oxynitrides, fluorides, sulphides, chalcogenides, etc...) inorganic non-metallic glasses, glass- ceramics, and ceramic/metal and glass/metal combinations in the form of nanostructured, bulk and graded materials and coatings, fibres, thin films, superlattices and other small confined systems, nanomaterials, nanocomposites and functional nanoparticles.

Focus will be on theory, modelling and simulation of materials and processes, green and advanced fabrication protocols (self assembly, particle beams, light irradiation, micromachining, colloidal processing...) and up-to-date characterization of structure, non-linear optical properties, tunability, nanosize effects etc. of novel inorganic photonic materials systems for light generation, detection, and manipulation including e.g. luminescent and laser materials, smart optical fibres, active plasmonic heterostructures, novel confined nano-micro structures etc. covering the UHV-IR electromagnetic spectrum.

Contributions from Academia and industry on upgraded or novel application and prospective new approaches to photonic-based technologies are also firmly encouraged.

Session Topics

CL-1 Photonic nanomaterials and nanostructures

- Optically active colloidal nanoparticles, nanowires, 1D and 2-D nanomaterials, nano/micro cavities...
- Optically active nanostructured materials
- Plasmonic nanostructures
- Nanophotonics
- Waveguide lasers
- Electro-optical and magneto-optical materials

CL-2 Luminescent and chromogenic ceramics and glass systems

- Phosphors
- Scintillators
- Other luminescent materials
- Chromogenic materials

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CL-3 Laser materials

- Fiber laser
- UV-Vis-NIR-MIR-laser materials
- Photonic crystals for laser applications
- Novel laser crystals - Mid-infrared laser Sources
- Novel visible lasers - Ceramic laser materials

CL-4 Inorganic optical fibers

- Passive, low-loss optical fibers
- Active and smart optical fibers
- Non-linear Fibers
- Fiber lasers (CW, Raman, and pulsed)
- Fiber and waveguide amplifiers (including Raman)
- Ultrafast fiber lasers
- Continuum sources

CL-5 Photons management

- Lasers
- Waveguides
- Luminescent systems
- Frequency conversion
- Switches, modulators
- Sensing
- Imaging
- Single photon sources and detectors
- Integrated optics

CL-6 Advances in characterization techniques

- Synchroton radiation based technologies (NEXFAS, XANES, XPS,..)
- Scanning probe microscopies, confocal microscopy, SNOM
- Interferometer techniques for imaging and testing
- SERS, CARS, Raman, Brillouin and optical spectroscopies - THz spectroscopies
- Advanced imaging techniques and innovative tools



CL-7 Ongoing applications and forecasts

- Solid state lighting, displays
- Optical communications
- Quantum technologies
- Bioimaging
- Healthcare
- Clean energy
- Aerospace, defense, security
- Structural health monitoring
- Laser-assisted manufacturing and micro/nano fabrication

Symposium CM Development and Application of Functional Transparent Conducting and Semiconducting Oxides

Oxide based electronics are seeing a broad set of applications based on new materials and the ability to tailor structure and functionality to enable new functionality. This includes improved TCs including hybrid nanowire TCOs as well as new semiconductors for high speed and wide bandgap electronics, new piezoelectric materials and photovoltaic absorbers. Achieving this requires an increasingly broad materials set but also structural diversity from amorphous to expitaxial and the inclusion of new hybrid materials. Critical in the development of oxide electronics and flexible oxide electronics are not only new materials but also a new level of interfacial control to enhance the control of specific charge transport across interfaces. There is also an increasing potential of the integration of ferroelectric or polar character to the materials and interfaces. Increasingly diverse structures with complex compositions and gradients as well as amorphous and crystalline metal oxide materials as well as wide band-gap nonoxide materials including e.g. nanowire networks and quantum dot structures are extending device designer's palette of transparent conductors and semiconductors by addressing a variety of cutting edge applications in flexible electronics, new active optoelectronics, even spin photonics. New advanced in materials and processing are also extending the range of the more experienced use of transparent conducting oxides in large area flat-panel displays, thin-film solar cells, antistatic coatings, functional and smart glasses and a number of other applications.

Underlying the development of new functional materials for example organic and nanotube based TCs is the need for a clearer and predictive understanding of basic materials science such as the electronic structure, carrier and trap origin, mobility and scattering, and doping mechanisms which govern conductivity and transparency, coupled with a better insight into interfacial and chemical compatibility issues and the development of models of the performance

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limits of materials and devices.

Objective of the International Symposium "Development and Application of new Functional Transparent Conducting and Semiconducting Oxides", which follows the discussions on related subjects held at previous CIMTEC Conferences, is to gather specialists from academia and industry to highlight updated developments in the area from fundamental science to materials synthesis, processing techniques device development and advanced/novel/prospective applications.

Session Topics

CM-1 Fundamentals

- Basic theory of functional electronic oxides
- Materials genomics of functional oxides including
 - o Electronic structure
 - o Doping mechanisms
 - o Carriers origin and dynamics
 - o Optimizing band structure
 - o Surfaces and interfaces in hybrid structures
 - Amorphous vs crystalline materials basic physics and application considerations
- Characterizations of basic TC properties including inoperando

CM-2 Material design and device development

- Advanced crystalline materials
 - o ZnO based materials
 - o p-type transparent conductors
 - o Indium-free TCOs
- Amorphous metal-oxide materials
- Non-oxide transparent conductors
- Nanowire/nanotube arrays and Q-dot based transparent structures
- Other novel materials/concepts
- Device characterisation and properties
- Growth approaches
- o PVD/CVD
 - o Atomic layer deposition
 - o Spin coating, spray pyrolysis and other chemical techniques
 - o Direct writing/printing/patterning
- Novel tools and equipment for device fabrication
- Interfaces and chemical compatibility issues
- Modeling and simulation of materials and devices

CM-3 Applications

- Flexible electronics (e.g. roll-up displays, electronic paper)
- Transparent devices (TTFTs) and applications including TC active layers
- Photovoltaics



- Piezoelectrics
- Incorporation of ferroelectric and polar properties
- Magnetic properties in functional oxides
- Wide Bandgap Power Electronics
- OLED/OPV
- Advances in smart /functional applications e.g. photocatalytic/active/protective coatings, smart windows, etc.
- Other advanced/novel/emerging applications
- Building applications
- Multifunctional materials including porous materials

Symposium CN Geopolymers, Inorganic Polymers and Sustainable Materials

Refractory inorganic polymers can be made at ambient temperatures and pressures. These materials include alumino-silicates or "geopolymers", phosphates and other chemically bonded inorganic compounds. The use of waste products such as fly ash or slag, or components derived from biological materials as starting compounds or as reinforcements in composites demonstrates the eco-friendly and sustainable nature of these materials. Novel potential applications of such composites include fire and corrosion resistant materials, infrastructure and construction materials, thermal insulation, porous materials, structural ceramic composites containing ceramic, metal or biological reinforcements, hydrogen storage, liquid and water purification, porous materials for CO₂ sequestration.

Main proposed matters for discussion:

Synthesis, processing microstructure Mechanical properties, thermal shock resistance Other inorganic analogues Composites Conversion to ceramics Waste encapsulation Infrastructure and construction materials Coatings (fire resistant, corrosion resistant) Novel applications Alkali activated cements Sustainable materials.

Session Topics

- **CN-1** Processing and microstructure
- **CN-2** Properties
- **CN-3 Structural and functional applications**
- CN-4 Definitions of geopolymers and alkali activated materials

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Symposium CO Science and Technology for Silicate Ceramics

Silicate ceramics account for over 80% of the ceramic industry turnover on a global basis. Future expansion is also predicted on increasing demand from construction and domestic uses, driven by improved life standards and demographic growth. In such a competitive and dynamic landscape, process and product innovation proved to be the key for growth. Ceramic technologies have been continuously upgrading and manufacturers are looking to industry 4.0 processing systems. The purpose of this symposium is to focus interest on ongoing R&D activities on silicate ceramics: wall and floor tiles, sanitaryware and tableware, bricks and roof tiles, ceramic technology and machinery, glazes and pigments, and raw materials. Matter will cover research work on the properties and behaviour of materials, quality assurance, development of new ceramic products and manufacturing technologies.

Session Topics

CO-1 Green and sustainable silicate ceramics

Social and technological challenges require a further effort to improve the sustainability of ceramic manufacturing. This session will take stock of technological solutions and processing innovation in the silicate ceramic industry (tiles, sanitaryware, glazes, bricks, etc). A special focus will concern health and environmental issues (e.g., CO2 emissions, crystalline silica, green certificates, reduction of wastes originated during processing) and all aspects of valorization of residues as raw materials in the manufacture of ceramics.

CO-2 Coating and decoration of silicate ceramics

The new scenario drawn by the advent of digital technologies is continuously evolving from decoration towards application of special effects, glazes and functional coatings. The last advances in surface coating and decoration by ink-jet printing and further drop-on-demand technologies will be

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reviewed. This session deals with materials development and behaviour (ceramic inks, engobes, effects, glazes, etc) including environmental sustainability and green chemistry in colorant manufacturing.

CO-3 Surface properties and smart silicate ceramics

Functionalized surfaces (self-cleaning, bacteriostatic or providing high reflectance, controlled grip, wear resistance, magnetic shielding, thermo-hygrometric comfort or energy harvesting).

CO-4 Properties and performance of silicate ceramics

The ceramic industry has to tackle the challenges coming from evolving market demand, new construction systems and product standards. This session will focus on innovative manufacturing of silicate ceramics (e.g., large slabs, 3D printing, novel granulation systems, etc). Durability, efficiency, scale-up to large surfaces, and testing procedures of multifunctional silicate ceramics are welcome.

Symposium CP Refractory Materials Challenges to Meet Current and Future Industry Needs

This symposium will continue its past focus on the development of "state of the art" refractory liner materials and on the advancements needed in material performance driven by changes in industrial processes or by the development of new processes. Drivers for change; such raw material availability, environmental concerns, controlling energy loss in processes, liner materials for evolving industrial process, or the need for relevant information on refractory material properties or on the processes contained by refractory materials will be discussed. Symposium topics will include sustainable refractory raw materials and product development; the installation of refractory material and the evaluation of finished refractory properties; the analysis of refractory wear/failure, thermal management, and thermodynamic process modelling; and how to address the education needs of refractory users and manufactures in a changing workforce. Contributed papers will include the achievements and challenges from the perspective of refractory producers, users, and academia; and will focus on shaped and unshaped (monolithic) refractory materials composed of natural and/or synthetic raw materials.

Session Topics

CP-1 Raw Materials Needs

- Natural raw material and their characterization and performance – including changing industry needs, reductions in energy consumption to produce raw materials, and raw material sustainability
- New/improved refractory raw materials and additives (natural and synthetic) to meet changes in refractory performance needs (wear, corrosion, or thermal management/insulation)
- Raw material phase relationships and reactions occurring during product installation, sintering, or use that impacts microstructure development and/or product performance
- Spent refractory reuse/recycling



CP-2 Product Testing and Quality Control

- Testing and improving physical properties; such as thermal shock, spalling, hot strength, fracture resistance, creep, thermal conductivity, and MOE
- Quality control and analytical tools used to improve
- refractory product quality, consistency, performance Evaluating and controlling monolithic materials property changes that occur during storage, mixing, installation, drying, and firing; including those caused by composition and additives
- Monitoring process variables and/or material properties related to refractory failure during service
- Microstructure analysis or phase changes as it relates to material performance (using SEM, TEM, cathodoluminescence, high temperature confocal laser microscopy, optical microscopy, or other analytical tools)
- Advances in refractory manufacture, installation, and/or system repair/maintenance

CP-3 Specialized Refractory Use/Issues

- Iron and steel
- Non-ferrous metals
- Preheat and hot work furnaces
- Cement
- Glass and ceramics industry
- Petrochemical, gasification, and waste incineration
- Industry wide environmental and recycling issues
- Needs in energy management/coolant water conservation

CP-4 Modelling and Simulation of the Process Environment

- Thermodynamic modelling and its use to understand/ control refractory properties/performance through predictions of material interactions
- . Thermal and stress management through modelling (thermal profile, materials diffusion, crack propagation, sintering, grain boundary motion, phase transformation, etc.)

CP-5 Refractory Failure Analysis

- Analysis of refractory liner corrosion/wear caused by slag, molten glass, metal, hot gases, particulates, or combinations of them targeting improved refractory performance
- Determining the causes of refractory failure and the use of that information to make necessary system changes

CP-6 Refractory Materials for Novel or Advanced Applications

- Fabrication and performance of ceramic liner materials made by additive manufacture
- Electrically conductive/non-conductive liner materials for magnetohydrodynamic systems
- The use of refractory grain as a stable structure for processes catalysts or as oxygen carriers in chemical looping combustion
- Other novel application requiring high temperature severe service materials or protective barriers (including battery materials, high temperature microwave processes, or high speed re-entry vehicles)



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CP-7 Future Refractory Testing and Refractory Education Needs (refractory producers, users, and industry)

- Refractory education needs brought about by the changing workforce, industrial environments, or changing process environments - what training/education is needed to meet those needs
- Needs for refractory wear or industrial process monitoring to ascertain refractory wear, material stability, or process performance

CP-8 Refractory Materials and Manufacturing Process Changes related to Global Decarbonization

The reduction of fossil fuel use and subsequent CO₂ emissions is causing industrial processes to be re-engineered, bringing about different refractory liner materials needs. This session will discuss drivers for change; such raw material availability, environmental concerns (including the need to reduce CO₂ emissions), controlling energy loss in processes, liner materials for evolving industrial process, or the need for relevant information on refractory material properties or processes contained by refractory materials. Examples of process changes include but not limited to:

- Iron and steelmaking practices shifting from the blast furnace/basic oxygen furnace process route to a direct reduced iron/electric arc furnace route.
- Other carbo-thermal/non carbo-thermal processes are being studied for potential CO₂ reductions, along with their possible impact on containment material needs. This would include processes for the production of Al, Cu, glass, and/or cement.
- Some industrial chemical processes, such as gasification used to produce synthesis gas for chemical and power generation, are being evaluated for lower temperature processing or for the use of non-fossil energy carbon sources (such as plastics). Many of the process changes will need a re-evaluation of refractory containment materials for material performance/service life.



CQ - 9th International Conference Advanced Inorganic Fibre Composites for Structural and Thermal Management Applications

Advanced inorganic fibre composites are enabling materials for a number of energy efficient and eco-friendly applications in aerospace, power generation, ground transportation, chemical, and nuclear energy applications. However, despite the considerable progress made in recent years in the fundamental understanding of inorganic fibre composites, a lot still remain to be done to fully utilize the excellent capabilities of these materials. A deeper insight of the mechanisms governing fibre composites behaviour in demanding situations, the development of reliable life prediction methodologies, design tools, and improved or innovative approaches to low cost manufacturing are among the many priorities for research and industry.

This conference (which follows the several ones on a similar subject held at previous CIMTEC Conferences) will feature latest achievements in the basic physico-chemical principles of inorganic fibrous composite technology and processing science, bulk and interface characterization, property assessment, and fiber composite design and production. Modelling of properties and behaviour, and application engineering studies in severe thermomechanical and aggressive environments are among its scope, as well as exploiting factors affecting reliability and low cost processing.

Ceramic (Refractory, Glass, Glass-Ceramic) Matrix Composites (CMCs), Ultra High Temperature Ceramic Composites (UHTCCs), Carbon-Carbon (C/C) composites, and Metal Matrix Composites (MMCs) are of great interest. In addition, new developments in the processing and manufacturing as well as characterization of reinforcements such as long and short fibres, filaments, nanofibers, nanotubes, and in-situ composites will also be covered.

Session Topics

CQ-1 Production and properties of reinforcements, preforms, and matrix materials

- Manufacturing, processing, properties.
- Fiber architecture: laminates, weaves, braids.
- Preforming methods and technologies.
- Nanoreinforcements (nanofibers, nanotubes, nanorods, nanowires, etc.)
- Development and testing of new inorganic fibers

CQ-2 Interfaces/interphase

- Fiber coating, interfacial bond control
- Structure and microstructure of interfaces
- Computational modeling of interfaces/interphases

CQ-3 Processing and fabrication of MMCS, CMCS, and C/C composites

- Solidification processing, extrusion, rolling, electrodeposition, etc.
- Reaction bonding, diffusion bonding, chemical vapour infiltration, melt infiltration, sintering, hot pressing, HIPing,

spark plasma sintering, colloidal processing, etc.

- Net shape processes, computer-aided component design and fabrication, rapid prototyping, process modelling.
- Additive manufacturing technologies
- Green and eco-friendly processing and manufacturing technologies
- Joining, attachment, machining, and repair technologies

CQ-4 Property, modeling and characterization

- Microstructural characterization, influence of processing on the microstructure
 - Thermomechanical properties, static and dynamic characterization
 - Micromechanics and interfaces
- Fracture, fatigue and creep mechanisms, plastic and superplastic behaviour.
- Wear and friction behavior
- Effect of strain, temperature and environment on microstructure and properties,
- Modelling at micro-, meso- and macroscopic level including environmentally induced damage, mechanical damage, toughness
- Environmental durability and life prediction
- High-temperature electromagnetic properties

CQ-5 Composites for thermal management

- Design, development, and testing of thermal protection systems (TPS)
- Light weight, high conductivity materials for thermal management (C/C and CNT composites, Al/SiC, Cu-based systems, Si_3N_4 in-situ composites, etc.)
- Bonding and integration technologies, thermal contact materials
- Nondestructive evaluation, quality assessment, health monitoring, etc.

CQ-6 Applications

- Aeronautics, space transportation systems, and space structures
- Aircraft and automobile brakes, friction components
- Power generation, fuel cells, microturbines
- Automotive and ground transportation, armors and shields
- Environmental and waste remediation, nuclear industries
- Chemical and process industries

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CR - 9th International Conference Science and Engineering of Novel Superconductors

Superconductivity is a fascinating quantum phenomenon with numerous useful applications, and it is of major interest both for its fundamental and technological point of view. Since the discovery of superconductivity in the cuprates and recently in hydrides, an outburst of research activity was generated, yet a key challenge remained the understanding of mechanisms of (un)conventional superconductivity, still under debate in spite of advances in research and materials development.

Meanwhile many new superconductors have emerged, including ruthenates, cobaltates, borides, borocarbides, doped fullerenes and intercalated graphite, organic, heavy-fermion superconductors, and novel hydrides and related materials. They are all accompanied by in-depth characterization of their physical properties by means of a variety of experimental approaches and by successful applications in wires, tapes, processing in electronics and in novel nano-structured technologies.

In recent years novel families of unconventional superconductors have been discovered and have stimulated strong scientific interest: the Fe-based pnictides REFeAsO, MFe2As2, Fe(SeTe), where high-Tc superconductivity is occurring without the Cu ions (characteristic element in cuprates) and in the presence of Fe ions, suggesting in turn that magnetic interactions are the essential ingredients for the underlaying microscopic mechanism. Furthermore, latest progress in hydride superconductors will receive due attention as the latest progress is very encouraging.

This Conference follows those on the analogous topics in 1990, 1994, 1998, 2002, 2006, 2010, 2014, 2018 organized in the frame of CIMTEC. On one side it will highlight the progresses achieved along the last years in the various issues of fundamental and technological character of the already known superconducting materials. On another side, the Conference will be focused on the recently discovered materials, their characterization, synthesis and processing and the prospective applications. Following the mission of the previous conferences of this type, the focus will be on novel aspects, issues and systems, but attention will be paid as well to all superconducting-related topics, including fundamental aspects of theory, advances in synthesis, functionalization and processing and the latest progresses in the areas of the devices at small scale and large scale ranges.

Session Topics

- CR-1 Materials, structure, physical chemistry and general properties
 - Oxides (cuprates, insulating cuprates, cobaltates,
 - ruthenates and other oxides)
 Borides and borocarbides (MgB₂ and other borides)
 - Carbon-based superconductors (fulleride, nanotubes,
 - organic superconductors, intercaled graphite)
 - Heavy-fermions superconductors and quantum-critical materials
 - Superconducting topological insulators
 - Interface superconductivity

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- New phases and metastable superconducting high-Tc materials
- Hydrides and related materials

CR-2 New superconductors of the pnictides and related families

- Structural properties (XRD, neutron scattering, electron diffraction, EXAFS, XANES, STM, SEM, TEM)
- Material processing (powder synthesis, single crystal and film growth)
- Order parameters, pseudo-gap, tunnelling, point-contact Andreev-reflection and related experiments
- Phase competitions, quantum critical points and other mechanisms for superconductivity
- Multiband character and related effects
- Superconducting fluctuations and related effects
- Superconductivity under pressure

CR-3 Properties of superconductors (of any type)

- Spectroscopic techniques (optical spectroscopy, IR, Microwave, Raman, NMR, ESR, μSR,inelastic neutron scattering, Mossabuer, AFM, XAS, acoustic spectroscopy)
- Photoemission and ARPES
- SQUID and tunneling spectroscopies
- Thermal, magnetic and electrical properties
- Electric field effect, structures and devices
- Pressure, strain and dimensionality effects

CR-4 Theory mechanisms and vortex lattice physics

- Correlation effects, spin liquids and quantum criticality
- Phonons, spin excitations and strong coupling
- Stripes, phases separation and granularity effects
- Pressure induced superconductivity
- CDW, SDW and superconductivity competition; coexistence of magnetism and superconductivity
- Vortex dynamics, flux pinning
- Vortex-defect interactions, defect structures, vortex penetration

- CR-5 Synthesis and processing
 Films, multilayer, wires, tapes and coated conductors
 Heterostructures and interface nanoengineering

 - Josephson junctions and JJ arrays
 - Nanostructured superconductors • Proximity and interface effects, hybrid structures
 - High pressure materials

- CR-6 Applications High power applications Low power applications and superconducting electronics





Symposium FA 3D Printing and Beyond: State-of-

Beyond: State-ofthe-art and New Paradigms for Additive Manufacturing Technologies

3D Printing (3DP) or additive manufacturing (AM) of advanced materials has changed the manufacturing platform during the past three decades. The idea of direct digital printing from a computer aided design file started with polymeric materials for touch and feel purposes. Now 3DP-based technologies are utilized in all sectors of product design and manufacturing from toys to aerospace to defence to biomedical to automotive, just to name a few. However, as the 3DP technologies are maturing, challenges related to use of different materials and manufacturing reliable parts are still active research fields. Moreover, novel adaptive and active functions that might be integrated in AM constructs by the use of an increasing palette of stimuli responsive materials add further spatial/temporal paradigms to additive manufacturing that open up new areas to research and application that were never done before.

This symposium aims at presenting timely research in additive manufacturing of advanced materials related to ceramics, metals, polymers and composites towards traditional as well as emerging applications including challenges related to design and fabrication of multi-materials structures.

Session Topics

- FA-1 Additive manufacturing of ceramics and composites
 - Emerging additive manufacturing technologies for ceramics and composites
 - Laser based additive manufacturing of ceramics and composites
 - Extrusion-based additive manufacturing of ceramics and composites
 - Additive manufacturing of ceramics and composites using binder jetting
 - Surface modification using additive manufacturing of ceramics and composites
 - Predictive theoretical approaches and multiscale modelling and simulation of materials and processes

FA-2 Additive manufacturing of polymeric, metallic and multi-material structures

- Emerging additive manufacturing technologies for polymeric, metallic and multi-material structures
- Challenges and critical issues related to large polymeric structures via additive manufacturing
- Topology optimized metallic structures via additive manufacturing
- Machine learning and additive manufacturing of polymeric and metallic materials
- Bimetallic and multi-material structures via additive manufacturing
- Fatigue performance of additively manufactured parts
- Powder processing and alloy design for additive manufacturing
- Multiscale modelling and simulation of processes, structural evolution, residual stresses etc.

FA-3 4D printing

- Embodying smartness in AM constructs
 - Polymer
 - Metals
 - CeramicsMultimaterial systems

FA-4 Applications of additive manufacturing technologies

- 3D printing and space
- 3D printing of electronic components
- 3D printing and energy systems
- 3D printing of biomedical devices
- Biofabrication and bio-printing
- Novel application of 3D printing

FA-5/FQ-8 3D Bioprinting of Soft Tissues and Organs (Joint Session with the Focused Session FQ-8)

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9th Forum on New Materials June 25-29, 2022

Symposium FB **Flexible and Stretchable Electronics:** Materials, **Devices** and Applications

Flexible and stretchable electronics is empowering unprecedented approaches to ubiquitous electronics: owing to its mechanical compliance, it offers opportunities for many new applications in energy transformation and storage, deformable displays, wearable electronic systems, memory devices, compliant large area electronics and in bioelectronics.

Major challenges for research is to achieve both excellent long-term reliable mechanical soundness and electronic performance, joined with compatibility with living tissues and low-toxicity when biomedical applications are involved. This symposium offers a suitable forum for discussion of timely research in materials, their mechanics, designs, modelling, novel phenomena and techniques enabling the economic fabrication of flexible, stretchable and ultraconformable electronics for the diverse fields of applications, as well as providing insights for future roadmaps.

Session Topics

FB-1 Materials and fabrication processes

- Emerging Organic, Inorganic and Hybrid active device materials (conductors, semiconductors, dielectrics) • Functional electronic inks for flexible and stretchable
- electronics
- Advanced growing, printing and patterning technologies for flexible and stretchable electronics
- Nonplanar fabrication processes
- Substrates and encapsulating/barrier materials and methods

FB-2 Device physics, mechanics and design

- Charge injection, transport and generation phenomena in materials for flexible/stretchable electronics
- Design of highly stretchable/deformable and conformable electronics
- Mechanics of thin film deposited on (or embedded in) plastic substrates
- Biomechanics of soft biological tissue/device interfaces
- Mechanical, thermal and electronic modelling of flexible/ stretchable hybrid electronic systems and components

FB-3 Applications of flexible/stretchable electronics

- Electronics and optoelectronics: flexible/stretchable thin film transistors, bendable/stretchable/conformable electronic circuits, sensors, light emitting diodes
- Flexible energy conversion/storage: solar cells, thermoelectric generators, fuel cells, batteries, supercapacitors, energy harvesters
- Biomedical: conformable neural interfaces, implantable soft devices, bioMEMS, prosthetic skin
- Transducers: e-textiles, wearable electronics, cyber-skin, flexible MEMS, microsensors, microactuators, etc
- Bio-inspired systems in organic electronics for biotechnology and medical applications

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Symposium FC

Research Advances on Micro/Nano Systems and their Applications

Advances in the research of innovative materials, sensors, and actuators constitute the building blocks for identifying new approaches for the integration of machine intelligence into Micro & Nano Systems. Moreover, technologies for the fabrication of devices and systems at micro- and nanoscales continue to advance and diversify due to the rising opportunities offered by the miniaturisation, functional integration and performance enhancement.

Both these fast technology developments will contribute to the growth in many areas of the research and will have an impact in: medical devices (e.g. Organ on a chip, Smart Patches, Implantable devices), Environmental monitoring, Internet of Things, automotive (e.g. smart cars), space (e.g. MEMS for microsatellites) and telecommunications (e.g. RFMEMS) and other important areas addressing societal challenges.

In order to satisfy all these expectations, the integration of heterogeneous micro-nano-technologies with new active, responsive, and nano-engineered materials, such as piezoelectrics, nanowires, graphene, bioactive and biodegradable ceramics and polymers, plays an important role. Novel advances in this sector of the research require delves into the state of the art of microsystems and in their applications.

The objective of the Symposium is twofold: a) to share the progress in the field and b) to identify the technological orientation and future challenges offered by the connection between innovative materials and micro/nanotechnologies.

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Pietro SICILIANO, IMM - CNR, Italy Osamu TABATA, Kyoto University, Japan Haixia ZHANG, Peking University, China The involvement of representatives of key research disciplines will offer a podium to enable community building and networking, the sharing of progress in both technology and application development, and the identification of common interests.

Subject matter include but is not limited to:

- -Advanced materials for sensors and actuators
- -Nanoscale and quantum effects
- -Innovative devices and sensing principles
- -Design, simulation and theoretical concepts
- -Technologies for MicroNanoBioSystems (MNBS)
- -System Integration and Electronics for smart sensors
- -Novel lithographic and nanotechnology approaches
- -Testing and reliability issues at micro/nano scales
- -Innovative applications

Application areas for MEMS/NEMS technologies of interest for this Symposium include but are not limited to:

-Mechanical, thermal and magnetic

- -Opto-mechanical
- -Power supply and energy harvesting
- -Fluidic microsystems and Lab-on-Chip
- -Biomedical
- -Data storage
- -Wireless communication
- -loT
- -Robotics

Session topics

- FC-1 Physical MEMS/NEMS; MOEMS/NOEMS
- FC-2 Chemical micro/nano-sensors and systems; Bio-MEMS/NEMS; microfluidics, lab-on-a-chip
- FC-3 Smart micro-nano systems and components integration
- FC-4 Radio frequency, energy harvesting and power supply MEMS

Symposium FD

Recent Achievements in Multiferroic and Magnetoelectric Materials

Single phase or composite materials that exhibit more than one type of ferroic ordering have attracted considerable interests in recent years for studies on the nature of cross-coupling between the ferroic orders and for useful applications in sensors, information storage and signal processing. In addition to traditional single phase multiferroics such as bismuth ferrite, significant advances have been reported on molecular, organic-inorganic, nonoxide, and 5d- multiferroics. Other topics of importance in



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single phase multiferroics are domain walls, magnetoelectric interactions in topological insulators, and multiferroic nanostructures. Investigations on composite multiferroics have focused on electric field control of magnetism and magnetic field control of ferroelectric order parameters, complex oxides and interfaces, ferromagnetic alloyferroelectric composites and self-assembled composite multiferroics. Significant progress has been reported on device applications for composite multiferroics in recent years and include efforts on magnetic sensors, high frequency devices, gyrators, energy harvesting and power electronics.

This Symposium, which follows the ones organized in previous CIMTEC conferences, will highlight developments in the understanding of the physics of multiferroic materials, theory, advances in materials synthesis and applications.

Of specific interests are: Theory and modeling of single phase and composite multiferroics, Advances in materials, synthesis and processing; New single phase multiferroic materials; Layered and multiferroic heterostructures; Nanocomposites and Self-assembly; Physics of interfaces; Magnetic field sensors; Memory application; Tunable, multiferroic microwave and mm-wave devices; Miniature antennas.

Session topics

- FD-1 Advances in materials synthesis and processing
- FD-2 Multiferroic nanostructures, self-assembly and nanocomposites
- FD-3 Magnetoelectric characterization and electric field control of magnetization
- FD-4 Multiferroics dynamics, new effects, devices and applications

Symposium FE Functional Nanomaterials for New Generation Solid State Chemical Sensors

Nanomaterials have been very important for various applications for many decades. The ability to selectively arrange nanosized domains of inorganic, organic and hybrid materials offers now an attractive route to engineer new nanostructured materials with unique combination of properties and multiple tunable functionalities that can be used in the chemical sensing field. Functional materials are to be considerate the heart of the sensor because they impact the sensitivity for quantification, recognition selectivity and specificity, as well as overall quality and robustness of the detection performance.

Due to their easy use, low cost and simplicity of operation, solid state chemical sensors based on electrical and electrochemical transduction principles are receiving increasing attention in both scientific and industria for their widespread range of applications spanning from comfort, safety, security, medicine to environmental monitoring and process engineering. Novel functional nanomaterials provide further advantages to address the demand for more sensitive, selective, stable, smaller size and and long-life electrical and electrochemical sensing devices.

This symposium aims at enlightening recent progress and perspective views of nanomaterials with very peculiar functional properties, including, carbon nanostructures, metal oxides, 2D-TMDS, graphene, inorganic and organic hybrids, and relative technology achievements applied in the field of solid state chemical sensors developments. Through the exploitation of the high reactivity of nanomaterials, due to their extremely high surface-to-volume ratio, very special surface states, quantum confinement effects and outstanding electronic properties, they address the demand for more sensitive, selective, stable, smaller size and low power consumption chemical sensor suitable for microelectronics integration and wide practical use.

Matter covered includes:

- Basic principles of chemical sensors;
- New functional nanomaterials for semiconductor and electrochemical sensors;
- Novel functionalization approaches by molecular engineering;
- Nanostructure design and control of the major factors affecting sensing performance;
- Sensor devices design and evaluation;
- Nanosensor architectures by top-down, bottom-up or combined approaches;
- Functional hybrid heterostructures;
- Integration process into macroscopic and micromachined substrates;
- Ongoing and prospective applications.



Session topics

- FE-1 Carbon nanostructures (CNTs, graphene)-based gas sensors
- FE-2 Semiconductor metal oxides-based gas sensors
- FE-3 Novel 2D inorganic materials-based gas sensors
- FE-4 Enzyme-free sensors based on functional nanomaterials
- FE-5 Nanocomposite/hybrid/heterostructure-based chemical- and bio-sensors

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Symposium FF

Electromagnetic Metamaterials and Metasurfaces: Recent Research Achievements and New Paradigms

Metamaterials belong to the class of artificial materials that can be engineered to exhibit properties that cannot be found in nature and offer the exciting new opportunities for controlling and modifying the flow of electromagnetic radiation. In combination with conventional materials, artificially engineered electromagnetic metamaterials open new ways to a number of applications in microwave, terahertz and photonic devices that range from super-resolution optical instruments and microwave antennas to photonic signal processing circuits. More recent developments include the expanding studies of metasurfaces, all dielectric metamaterials, and hybrid metamaterials and metadevices incorporating graphene and other two-dimensional materials, whereas topological photonic and quantum metamaterials, software-discovered metamaterials and cognitive metamaterials are among the new paradigms that keeps generating considerable excitement for their promise of new applications and to further expand the limits of modern information and communication systems.

This Symposium, that follows the ones on the same topic held at previous CIMTEC conferences, seeks to enlighten recent progress and stimulate an open discussion among experts of this multidisciplinary fascinating area of research with a view on the perspectives opened by exploring its potential in present and forecast applications.

Contributions are expected to cover the following and related focus area:



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- Physics and modelling of metamaterials systems
- Microwave and THz metamaterials
- All-dielectric metamaterials and metasurfaces
- Nonlinear, tunable and active metamaterials
- Applications of metamaterials and metadevices
- Antenna, nanoantenna and waveguide applications
- Cloaking and transformation optics with metamaterials
- Superlenses and near field imaging
- Artificial intelligence metamaterials
- Quantum metamaterials
- Topological photonic metamaterials
- Neuromorphic and cognitive metamaterials
 Novel concepts for devices and applications

Session topics

FF-1 Physics and modelling of metamaterials / metadevices

Symposium FG

Advances in

Inorganic Luminescent Materials

- FF-2 Novel concepts and new materials
- **FF-3** Mie-resonant nanophotonics
- **FF-4** Functional metasurfaces
- FF-5 Quantum and topological meta-optics
- **FF-6** Active metamaterials

Session topics

- FG-1 Physics, modelling, processing and characterization of luminescent materials
- FG-2 Phosphors, quantum dots and low dimensional materials for lighting and displays
- FG-3 Advances in scintillator development and upconversion materials
- FG-4 Sensing and imaging
- FG-5 Chemi-, bio-, sono-, thermo- and mechanoluminescence
- FG-6 Light management for active applications and luminescent materials integration in devices
- FG-7 Medical applications and bioimaging

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Luminescence in inorganic materials arises from excitation from excitation from an external energy source, biochemical and chemical changes or reactions. This symposium covers theoretical and experimental aspects of the luminescence phenomena in insulators, semiconductors, disordered and amorphous materials and in structures such as micro-cavity, photonic and plasmonic ones. Luminescent materials have wide applications: solid-state lighting, detectors, imaging

wide applications: solid-state lighting, detectors, imaging analysis, display devices such as field emission, plasma and electroluminescent, biomarkers, medical diagnostics and photodynamic therapy, amplifiers, lasers, security labelling and energy conversion. Luminescent centers, energy transfer and migration, excited state dynamics, collective phenomena and spectroscopic methods and analyses are topic areas. The challenge to develop new compounds along with novel synthesis methods to form nano- to single-crystal compositions and methods to characterize the luminescence phenomena are included. Progress on scintillators, upconversion materials, sensor and imaging materials are covered. The goals of this symposium are to highlight recent progress, promote discussions among the participants and further develop concepts for the application of luminescent materials.

FH - 4th International Conference **Emerging Materials**, Technologies and Applications for Non-volatile Memory and **Memristive Devices**

Non-volatile memory and memristive devices are currently key elements of several electronic and portable systems, and their market and potential applications are expected to continuously increase in the next years, also towards inmemory and neuromorphic computing. Several advanced concepts (RRAM, CBRAM, PCM, MRAM, Electrochemical memory /ECRAM), STT-MRAM, FRAM, 2D based memristive devices, threshold switching,....), exploiting innovative materials and physical mechanisms, are under investigation to achieve better performance, higher scalability, and to address novel applications for more efficient, intelligent and secure computing systems. Besides pursuing the downscaling of non-volatile memories in terms of minimum size and integration density, the new paradigm is also directed to devices that can integrate multiple functionalities, such as computing and storing information at the same time. This approach will enable the fabrication of novel low power nanoelectronics circuits with potential applications in several fields, including computation schemes emulating the brain functionality, flexible electronics and non-volatile logics.

This symposium will address recent advances on nonvolatile memory devices and memristive systems, with focus on innovative storage concepts, new materials and devices, integration schemes and selectors for the storage elements, understanding and modelling of the physical mechanisms for data storage down to the nanoscale, memristive devices and novel applications for von Neumann Computing and beyond.

Session topics

FH-1.1 Phase Change Memories (PCM): materials, devices and applications

- Advances in materials and technologies for phase change memories (PCM)
- Advanced characterization techniques, theory and modelling of PCM
- New materials and concepts for PCM, including lowdimensional cells, layered and super-lattice phase change materials

FH-1.2 Resistance switching memories and advanced memristive devices

- Advances in materials and technologies for resistive memories (RRAM)
- Advanced characterization techniques, theory and modelling of resistive memories
- Electrochemical memory (ECRAM) and Redox transistors • Memristive device systems based on graphene and 2D materials
- Polymer-based and hybrid organic & inorganic memory devices
- Nanowire-based memristive devices

- 3D architectures, cross-bar arrays and advanced selectors
- Optical and photonic memories
- Radiation-hard memories and space applications

FH-2 Magnetic and ferroelectric memories: materials, devices and applications

- MRAM and spin transfer torque (STT) MRAM memories, racetrack memory
- Domain wall, magnetic skyrmions
- FeRAM and ferroelectric FET
- Memory based on ferroelectric tunnel junctions
- Novel materials including organic ferroelectric and magnetic nanostructures for memories
- Advanced applications of ferroelectric and spintronic devices

FH-3 Emerging applications for non-volatile memories and memristive devices

- Emerging materials and devices for neuromorphic computing
- Metal-Insulator-Transition materials and devices
- Photonic memories
- Devices for in-memory computing and reservoir computing
- Nanowire networks
- Memristive devices and novel memristive-based circuits
- Non-volatile logics based on resistive memories and hybrid CMOS/non-volatile memory circuits

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Symposium FI

Graphene and Other Emerging 2D-layered Nanomaterials: Synthesis, Properties and Potential Applications

Recent advances in atomically thin two dimensional (2D) materials have led to a variety of promising future technologies for post-CMOS nanoelectronics, energy, photonics and opto-electronics. The 2D materials exhibit strong in-plane bonding along with weak out-of-plane bonding, enabling the exfoliation of the materials into single crystal two-dimensional flakes with atomic level thickness. An atomically thin 2D material is defined as a material whose free charges are immobile in one spatial dimension, but mobile in the other two. This property enables 2D materials to have new or superior functions, distinct from traditional bulk materials or thin films.

This symposium will review recent progress in understanding the atomic scale growth mechanisms and structural control of various 2D nanostructures, developing new growth techniques, revealing novel properties, exploring new chemistry of 2D structures, functionalization engineering in low dimensions and their applications in areas such as electronics, opto-electronics, sensors, composites and energy.

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Session topics

- FI-1 General physical and chemical properties, structural and electronic characterization of graphene, graphene oxide and of single and few-layered 2D compounds: such as nitrides, oxides, dichalcogenides, silicene, MXenes, 2D polymers.....
- **FI-2** Novel properties including spin, spin-orbit, magnetic, superconducting, thermal, thermoelectric, piezoelectric, excitonic, catalysis-related etc.
- FI-3 Synthesis, processing and microstructure of graphene and other 2D layered compounds and their composites
- FI-4 Integration processes of graphene and other 2D layered materials in devices structures.
- FI-5 Novel characterizations routes such as high-resolution imaging, chemical/spectro-scopic analysis, ultrafast methods, in-situ approaches or properties under extreme conditions, new computational approaches, 2D materials by design including genomic approaches
- FI-6 Application of graphene and other 2D layered materials and composites.
 - Electronics, optics, optoelectronics, plasmonics (transistors, field emitters, transparent electrodes, sensors, optical modulators, touch screens, light emitters, nanoantennas....)
 - Energy generation, conversion and storage (fuel cells, photovoltaic cells, thermoelectric generators, batteries, supercapacitors...)
 - Environmental applications (catalysis, ultrafiltration...)
 - Biotechnology, bioengineering and medical applications (DNA translocation, smart drug delivery, tissue engineering, contrast agents/bioimaging, theranostics, neural interfaces...)
 - Structural materials
 - Other





Symposium FJ

Advanced Photocatalytic Materials for Energy and Chemistry in Transition and for the Environment

The use of solar energy to driven the chemical and energy processes, and the chemical storage of solar energy are crucial aspects to move to a low-carbon economy, sustainable society and to foster transition in energy and chemistry. There is a fast-growing scientific interest on this subject, with emerging new directions and applications also at industrial level. Realize this challenge requires the development of new ideas, concepts and innovative photocatalytic materials. Photocatalysts are widely utilized to clean and remediate our environment and their use in advanced devices to produce electrical energy or solar fuels in rapidly expanding. Semiconducting photocatalytic materials possess multi-functional properties, which allow their use in various areas from photocatalytic environmental remediation, water splitting for hydrogen fuel, CO2 reduction, self-cleaning coatings, electrochromic devices and sensors, and low cost solar cells. New emerging area will include the development of new technologies to convert small molecules such as O2, N2 and CH4, and the coupling between photocatalysis and non-thermal plasma chemistry. The nano-architecture design of these materials is of crucial relevance to achieve these different functional characteristics and realize an efficient energy conversion. There is the need to gather together multiple competences to accelerate the development of these nanomaterials for solar energy and environmental applications.

This Symposium aims to provide a multi-disciplinary forum for scientists, engineers and industry experts to break new ground in the discussion, and realize a cross fertilization and progress in the understanding of the design criteria for their use. Among the recent developments that will be highlighted in the symposium are advances in synthesis of novel materials with tailored nano-architecture; the preparation of thin films and nanostructures; the advanced characterization by experimental and theoretical methods of these materials and of their structure-performance relationships; processing techniques, device fabrication and stability; advances in environmental applications and in air quality improvement; novel concepts, technologies and materials for photocatalysis.

Session topics

FJ-1 Design elements and advanced concepts for photofunctional materials

- Band-gap engineering of photocatalysts: optical, electronic, and catalytic modifications
- Multiphoton band-gap engineering, photonic materials
- Superhydrophilic, amphiphilic and antifogging surfaces
- Hybrid photocatalytic nanomaterials, Heterojunctions
- Optimizing interfaces in multilayer systems

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- Photocharges transport and semiconductor architecture
- New types of quantum-dots and robust sensitizers, antenna effects
- Emerging photoelectronic materials such as nanoscale plasmonic metal particles, quantum dots, and 2D materials

FJ-2 Understanding fundaments of photoinduced processes and charge transport

- Charge transfer and recombination
- Theoretical and computational investigation
- Computational screening of new materials
- Relation between nanostructure and photofunctional behavior
- Photoelectrochemical devices

FJ-3 Design approaches for advanced applications

- Development of high surface area and porous photocatalytic materials and photoanodes
- Photoactive nanodevices, hierarchical photoactive materials
- Innovative materials for third generation solar cells (dye sensitized solar cells, quantum dot cells, tandem/multijunction cells, hot-carrier cells, etc.)
- Photocatalytic solar fuel (H2, CO2 reduction) generation and
- Photocatalytic activation of small molecules (O2, N2, CH4)
- Selective photo-oxidations for organic synthesis, tandem systems
- Environmental applications: air / water treatment, antibacterial surfaces
- Photo-catalytic fuel cells, artificial leaf
- Designing element to improve stability, scalability, and cost
- Metal-free photocatalysis



Symposium FK

Thermoelectrics: Materials Research and Application Technologies

This symposium, which follows a series of previous editions at CIMTEC, is focusing on research and development issues critical to the advancement of solid-state thermoelectric conversion technologies and their infusion into a significantly wider range of applications.

Since the mid 1980's, significant research efforts have been devoted to the discovery, characterization and optimization of advanced thermoelectric materials. In spite of significant gains in the peak dimensionless thermoelectric figure of merit, ZT, when it comes to practical applications, it has proven extremely challenging to displace materials discovered in the 1950's and 1960's, namely Bi2Te3 and its alloys, PbTe and its alloys, and Si-Ge alloys. Bi2Te3 alloys remain the only commercial-scale thermoelectric material that is used today for thermal management and low grade waste heat power applications. For power generation, there are several reasons for this situation, but the main one being that a novel high performance thermoelectric material is but step one of a lengthy technology development lifecycle that must be successfully completed for enabling infusion into

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applications. For thermoelectric cooling, the main challenge has been to achieve significantly better performance than the state-of-the-art Bi2Te3 technology.

The symposium will be organized along three main thrusts: 1) Theoretical and experimental thermoelectric transport and materials research, including big data approaches for new materials discovery; 2) Solid-state thermal-to-electric and direct energy conversion device research and modeling, including bulk materials and thin-film device architectures; 3) Converter technology research, development and infusion, including design, modeling, characterization, advanced processing and extended performance testing of device materials, elements, interfaces, and applicationscale systems.

Session topics

FK-1 Thermoelectric Materials Research & Characterization

- Theory and modeling
- Materials discovery
 Bulk inorganic materials, including nanostructures and composites
- Organic and polymeric materials
- Low dimensional materials
- Nanostructures and nanocomposites
- Mechanical properties

FK-2 Solid-State Device Research and Modeling

- Energy conversion mechanisms
- Thermoelectric device design & architectures
- Direct energy conversion
- Device modeling and simulation

FK-3 Converter Technologies and Applications

- Terrestrial and space applications opportunities
- Technology needs and priorities
- Advanced manufacturing and rapid prototyping approaches
- Device, converter technology development and infusion demonstrations
- Converter and system modeling and simulation
- Metrology and standardization



CIMTEC

9th Forum on New Materials June 25-29, 2022

Symposium FL Stimuli Responsive and Multifunctional Polymers: Progress in Materials and Applications

Modern applications for polymeric materials such as batteries, flexible electronics, medical devices and implants, controlled drug delivery systems as well as smart textiles and robots have complex requirements towards material properties and functions. Functions comprise electrical conductivity, stimuli-sensitivity, actuation, degradability, specific structural functions, transport of heat energy and substances, magnetic functions as well as biofunctionality. Often combinations of functions are demanded, which are not automatically linked by each other, but need to be implemented almost independently in a material system. Different strategies are pursued for gaining multifunctionality: molecular integration by incorporating (different) functional groups, establishing of functions on different length scales and creation of multimaterial systems, in which each component contributes a function or new functions are resulting from their combination. Sustainability aspects are playing a role in the context of the raw materials used, which should preferentially be from bio-based sources, recyclability of the material system as well as energy saving processing, e.g. by use of integrated processes combining synthesis and shaping. This symposium covers all areas of research in this field including computational design and synthesis of stimuli-responsive and multifunctional polymers, their processing, especially

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additive manufacturing and application development based on these materials.

Session topics

- FL-1 Shape-memory polymers and actuators
- FL-2 Degradable, stimuli-sensitive polymers
- FL-3 Stimuli-sensitive gels
- FL-4 Multifunctional (nano)composites and surfaces; multi-material systems
- FL-5 Pharmaceutical and medical applications of smart polymers
- FL-6 Additive manufacturing for multifunctional materials
- FL-7 Multifunctional materials for soft robotics

Symposium FM State-of-theart Research and Applications of Shape Memory Alloys

Shape memory alloys respond to the increasing demand of smart and multi-stimuli responsive systems. Shape memory, pseudoelasticity, damping capacity and adaptive properties can find application in important sectors such as biomedicine, aerospace, building technologies, and advanced electromechanics. Although the majority of applications is based on NiTi alloys, an increasing effort has been devoted to the research of new materials: e.g. Ni-free, high temperature, composite, magnetic materials. Magnetic shape memory alloys are also magnetically responsive. They show a variety of multifunctional effects that open new exciting fields of research and applications. These include ferroic cooling, energy harvesting and magnetic actuation. The control of the materials properties at different lengthscales is crucial for their fully exploitation. Advanced manufacturing methods, e.g. additive manufacturing, are particularly interesting for the realization of advanced geometries and architectures and the exploitation

geometries and architectures and the exploitation of compositional gradients. On the other hand the development of micro and nano-fabrication techniques enables wide perspectives of application and integration in microsystems.

This Symposium will highlight recent developments in the realization and property optimization of shape memory alloys, covering both fundamental aspects and applications.

The Symposium will welcome contributed papers related to the design, simulation, theory, processing, characterization and optimization of materials and devices.

Session topics

FM-1 Materials and materials design, basic phenomena and theory, functional properties

Shape memory alloys (SMAs), magnetic SMAs; high temperature SMAs, Ni-free SMAs, nanocrystalline SMAs, foams, composites, advanced architectures.

Transformation behaviour, crystal structure and microstructure, magnetism, characterization techniques, theory and simulation.

Thermomechanical, magnetomechanical, elastocaloric, barocaloric, magnetocaloric and other multifunctional properties.

FM-2 Thin films and micro nano-systems

Thin and thick films, micro and nano scale processing, interconnection technologies.

FM-3 SMAS engineering and applications

Micromechanical models, macromodels, FEM simulations, constitutive behaviour, fatigue, failure mechanisms, corrosion, effects of thermomechanical processing. Micro and nanodevices, sensors, actuators, harvesters, textiles. Aerospace, automotive, energy, biomedical, electromechanical, civil-seismic applications.

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Symposium FN

Smart and Interactive Textiles - From Nanoengineered Textile Fibres to Integrated Wearable Systems

The sensing/adapting/responding, multi functionality, low energy, small size and weight, ease of forming and low cost attributes of SMART Textiles and their multidisciplinary scope offer numerous end uses in Medical, Sports and Fitness, Military, Fashion, Automotive, Aerospace, Built Environment and Energy industries. The quest of these new and high value materials cross scientific boundaries redefine material science, design and engineering and find new uses. As such SMART and Interactive Textiles are particularly important to life quality and in sustaining energy and our environment.

The smart and interactive textiles market size will exceed USD 6.5 billion by 2024, with the healthcare and well-being sectors being a significant driving force and Telemedicine enabled with sensor-based garments is expected to exceed 50% CAGR in the next 5 years.

Research for highly specific applications is increasing in exploring the opportunities offered by manipulating textile materials down to the nanoscale for creating new "smart" adaptive/active functionality, and by the development of "E- textiles" offering intelligent flexible integrated systems capable of sensing, actuation and wireless communication in the form of intelligent high-tech fabrics and wearable garments. The development of these systems presents a complex set of interdisciplinary challenges that includes materials design, hierarchical integration, control strategies and manufacturing.

This symposium, following the successful tradition of previous CIMTEC events on the same subject (2010, 2014) and 2016), will address the latest research on adaptive and active textiles and garments stemmed from the use of novel materials, and by the effective design and integration of devices for bio sensing, diagnostics and actuation, based on electrically, optically and mechanically functionalized fibres, yarns and fabrics. Hence areas of research focus of the symposium are on nanomaterials; their morphology, functionality and performance, on actuators, sensors, connections, energy generation and storage, and on communication devices for smart textiles and wearable systems. The industrial sectors being covered are diverse and not limited to medical, sport and fitness, fashion, automotive, aerospace, energy , architecture, personal protection, military and the Internet of Things.

Translation aspects from laboratory to commercial products, including industrial processes, manufacturing strategies and consumer demand, will also be relevant for the symposium



as a matter for discussion and sharing of expertise from academia and industry.

Session topics

FN-1 Adaptive/Active Textiles

- Novel concepts for nanoscale modification of the intrinsic properties of fibres by making them sensitive to physical and (bio)chemical environments
- Integrating/dispersing /coating textiles with stimuliresponsive organic and inorganic materials (e.g. electroactive, shape memory, chromogenic, etc.)
- Hybrid nanotextiles; functionality and performance
- Textile sensors

FN-2 e-Textiles

- Advances in conformable electronics for fabric based devices
- Embedding sensing/actuation/communication capability (e.g. sensors, processors, power sources, interconnects, antennas) into functional fabrics and into wearable wireless platforms
- Advances in fibertronics and e-textile hybrid systems
- Electronics OEMs and components
- Packaging issues
- Sensor networks, data mining, signal processing and control
- Intelligent Integrated Wireless Systems

FN-3 Functionality, Manufacturing, Application

- Functionality: Sensing and actuation; communication and information; energy harvesting and storage, environmental protection; thermal regulation; optical/ photonic; antibacterial: self-cleaning, hydrophobic; selfshaping, self-healing...
- Manufacturing: Textile processing and manufacturing from lab. to large scale; testing; qualification; reliability; field trials
- Applications: Healthcare, medical, ergonomics, rehabilitation, sport and wellness, telemonitoring; personal mobile systems; fashion; military and security; lighting; civil engineering, structural monitoring and control; transportation; energy and environment...

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Symposium FO Embodying Intelligence in Structures and Integrated Systems

Research is actively pursued aimed at applying multifunctional capabilities of smartness and intelligence to existing and novel structures and systems. Degree of smartness/intelligence varies from semi-passive smart materials, which adaptively respond to an external stimulus, by varying some of their characteristics, to mechatronic systems that embody the inherent capability of self-sensing, diagnosis and control by the synergistic integration of smart materials, sensors, actuators and control electronics. The dream is for future structures and systems, where integrated smart devices would be used to sense exogenous stimuli and internal material conditions decide on course of action, and then autonomously implement an effective reaction strategy.

A number of applications and integrations of smart materials, devices and structures into industrial systems are emerging nowadays. More are in the offing, driven by the availability of new multifunctional materials and by the exponential increase in computing capabilities, and refined design, modelling, control and optimisation strategies that create the premises for a potential expansion to smart autonomous structures and systems.

The symposium, which follows the ones on the same subject organized in the frames of CIMTEC 2008, 2012 and 2016, will highlight advances in adaptive materials and in novel sensor/actuator and micro systems, and their integration in mechatronic structures and systems of various complexities.

Among the scopes of the Symposium will be:

- i. Physical mechanisms, constitution behaviour, processing characterization and modelling of new smart and multifunctional materials and devices for intelligent structures and systems,
- ii. system level evaluation of smart structures,
- iii. the interplay of actuation, sensing and processing capabilities,
- iv. the ideation and numerical modelling and simulation of new actuation and sensing techniques for integrated systems,
- v. the analysis, design and testing of active/passive smart dynamic and static structural components and signal processing,
- vi. micro and nano technology, control electronics and materials science involved in interfacing different materials and functions,
- vii. reports on traditional industrial systems where the incorporation of smart materials and integrated devices favours an enabling new capability or remarkable performance enhancement and/or cost reduction,
- viii. solutions to new industrial and commercial applications of smart materials and integrated structures that have well matured beyond the concept stage and new ideas and directions for future developments.

Contributions are sought from experts of materials science, theoretical and applied mechanics, electronics, electromechanics and manufacturing.

Session topics

FO-1 Smart Materials/Sensors/Actuators/MEMS/NEMS

- Ferroelectrics, piezoelectrics, electrostrictives, magneto
 - strictives
- Shape memory metals and polymers
- ER/MR fluids, ferro-fluids
- Multifunctional (nano)materials and (nano)composites

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- Self healing materials systems
- Multifunctional sensors and sensor networks
- Wireless sensors networks
- Sensors for harsh and extreme environments
- Fibre optics sensors
- Nano-sensors
- Actuator and nano-actuator devices
- MEMS/NEMS technologies
- Physical mechanisms, constitutive behaviour
- Software tool and optimal design
- On-duty smart materials and devices behaviour
- Modelling of smart materials and sensor/actuator performance

IMTE

FO-2 Integration Technologies

- Embedded and distributed sensors: simulation, performance, self-diagnostics
- Sensor characterisation, qualification, standardisation, reliability
- Sensor/actuator coupling with structure, interfaces and interfacial problems
- Energy transfer mechanisms, structural dynamics
- Energy harvesting and scavenging
- Integrated micro- and nano-structures
- Mechatronic systems integration
- Model development and control design for integrated systems and microsystems
- Optimisation techniques for sensor/actuator selection, architecture and feedback design
- Signal processing: data mining, neural networks, data fusion for large sensor arrays, fault recognition and recovery
- Remote control and communication

FO-3 Smart Structures and Integrated Systems

- Passive, active and hybrid vibration control systems
- Active and semi-active shape control
- Smart components, devices and sub-assemblies
- Nastic and morphing structures
- Fault tolerant structures
- Structural health monitoring
- Damage detection, mitigation and repair
- Remote sensing
- Adaptive and self/diagnosing structures
- Autonomous intelligent structures and sensing systems

FO-4 Ongoing and Perspective Applications

- Aerospace, MAV/UAV
- Morphing systems
- Civil engineering
- Defence
- Naval and ground transportation
- Marine and offshore structures
- Flexible robotics
- Energy systems
- Communication technologies

Special Session FO-5

"Autonomic, Adaptive and Self-Sustaining Systems"





Symposium FP Biological, Biohybrid and Bioinspired Materials: From Electronics and Photonics to Medicine

Living organisms have developed by evolution a wide variety of apparatuses to perform sophisticated functions with optimized efficiency and selectivity. These include not only biochemical transformations, but also physical processes such as interaction with light (i.e. absorption, emission, refraction), ionic and electronic charge transport. The accomplishment of these functions is made possible by a multiplicity of diverse molecular and supramolecular structures which have been perfected along the evolution timescale.

Increasing interest has been raised over the last years by implementation of biological and bio-inspired materials in photonic and electronic devices, and also in bio-medical applications. Even more interestingly, ground-breaking results have been recently shown by the direct use of living organisms to produce the materials, or as scaffolds for direct in vivo devices assembling.

The symposium "Biological, biohybrid and bioinspired materials: from electronics and photonics to medicine" will cover many classes of biological and bioinspired materials for a number of applications. These include, but are not limited to, materials from photosynthetic organisms (e.g. pigments, reaction centers, plants), biological polymers (e.g. cellulose, silk, lignine, melanins, DNA), bio-inorganic materials (e.g. biosilica, calcite, magnetite). The symposium will mainly focus on the materials, but also the optoelectronic/photonic devices and biomedical applications will be covered, aiming to combine the fundamental understanding of the mechanisms underlying the biological materials' properties with the applications.

This symposium will set up a forum of discussion enlarging the community of researchers traditionally involved in materials science by including the contribution of biologists and biotechnologists, thus eyeing up new directions and languages for advancing this revolutionary scientific and technological field.

Session Topics

- FP-1 Classes of materials and their (bio)synthesis, structure and chemical modification
 - materials from plants and photosynthetic organisms
 - biosilica, calcite, magnetite and other bio-inorganic materials
 - biopolymers (e.g. cellulose, silk, melanines, lignine)
 DNA

FP-2 Electronic devices with biological and bio-inspired materials

- sensors and actuators
- photodetectors
- memory devices
- transistors
- electronic interfaces with living cells and tissues

FP-3 Photonic devices with biological and bio-inspired materials

- photonic crystals
- waveguides
- lasing
- structural colors

FP-4 Bio-medical devices with biological and bio-inspired materials

- materials for drug release
- antimicrobial materials
- platforms for regenerative medicine
- neuronal interfaces

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9th Forum on New Materials June 25-29, 2022



FQ - 13th International Conference **Advanced Biomaterials** and Nano-biotechnology for Medicine

The convergences of materials, electronics and biological systems at the nanoscale are fuelling unprecedented opportunities in the biomedical field through groundbreaking inventions / innovations in diagnosis and therapy. Major objectives of this conference, which follows the conferences on the same subject held in previous CIMTEC editions, is to provide a synergic approach covering applied chemistry and physics, materials science, electronics, biochemistry and medicine to enlighten how deeper insights into biological events and their interplays with nanotechnology can support the development of new generations of materials, micro- or nano-devices, molecular level approaches and advanced characterizations to address major medical problems.

The conference particularly aims to report recent progress in the synthesis and characterization of new or creatively modified stimuli-responsive, active and multifunctional metals, ceramics, polymers, gels; smart nanoparticles, functionalized I-D and 2-D nanostructures, Q-dots; hybrids, composites, selforganized materials, hierarchical bio-nanostructures; as well as the potential for their implementation in selected challenging areas of nanomedicine such as (i) multi-scale approaches to regenerate and engineer new soft tissues and hard tissues,

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(ii) innovative targeted drug delivery and release platforms, and (iii) new materials and systems for medical diagnosis and therapy including multi-modal theranostics.

Three Focused Sessions on latest developments on implantable neural interfaces (FP-6), on wireless body sensor networks for healthcare applications (FP-7), and on progress in 3D bioprinting of soft tissues and organs (FP-8) will complement the Conference programme.

Overall, the study of systemic interactions in the body environment such as side effects, biocompatibility and biofunctionality will be essential issues to promote the discussion for bioinspired strategies in materials and device design to be effectively implemented into clinical practice.

Session Topics

FQ-1 Advances in biomaterials: synthesis, processing, characterization, functionalization, finalization

- Bioactive, biodegradable, multifunctional ceramics, glasses, and metals
- Bioactive, biodegradable, stimuli-responsive, multifunctional polymers, gels, and elastomers, liquid crystalline polymers, composites, and hybrids
- Bioinspired, biomimetic, self-organized, hierarchical materials
- Microbiome-supporting and immunomodulatory material
- Multifunctional nanostructures and nanoparticles
- Modeling of biomaterials and their functions

FQ-2 Tissue engineering and regenerative medicine

- Biofabrication of cells and tissue constructs, multi-phase and multi-functional scaffolds, microfabrication techniques
 - Vascularization of tissue engineered constructs
 - Biomaterials for tissue interface regeneration (ligament/ tendon/cartilage-to-bone)
 - Biomaterials for modulating stem cell microenvironment
 - Growth factor delivery vehicles
 - Mechanistic effects of materials, cell attachment, proliferation, differentiation
 - · Biomimetic materials for engineering load-bearing tissues, self-healing mechanisms
- Biomechanics of soft tissues and hard tissues
- Evaluation of tissue engineering constructs in laboratory and/or pre-clinical settings
- FQ-3 New therapeutics and intelligent drug/biomolecule/ gene delivery systems
 - Advances in system-responsive materials for delivery systems. Controlled release systems, triggering mechanisms
 - Drug targeting, targeting and imaging agents to site-specific deliverv
 - · Biomaterials constructs for temporally controlled release of multiple factors
 - Progress in imprinted recognition release systems and implantable micro- or nano-delivery devices
 - In vitro and in vivo studies, models for drug transport, absorption metabolism, retention mechanisms and toxicological issues

FQ-4 Bio-imaging and theranostics

- Inorganic and organic nanoparticulate systems for bioimaging
- Functionalized agents/devices for in vitro and in vivo imaging and diagnostics
- Theranostic nanocarriers, multimodal theranostic agents
- Multifunctional theranostic nanoplatforms
 - Biomedical imaging (MRI, MPI, PET, SPECT, ...)

FQ-5 Clinical translations

- Muscoloskeletal, cardiovascular, nervous system, dentistry, ENT surgery, etc
 - Modelling of tissue/implant system
- Biocompatibility, biodegradation, host response
- Qualification and testing methods
- Studies on retrieval implants



Focused Session FQ-6 Next Generation Implantable Neural Interfaces

Interfacing of external electronics to the human nervous system has been already shown to provide a powerful tool to better sensing, understanding and modulating neural functions at the central and peripheral levels. The development of implantable neural interfaces has enabled large-scale and high-resolution recording of neural populations in vivo and opened new application perspectives for neuroscience and for the therapy of neurological disorders. If, on one hand, a new investigation window has been opened on brain function by getting better access to brain microcircuits, on the other hand these novel neural interfaces may represent a means to partially restore lost functions in the nervous system of neurological patients. The reliability and endurance of the implant, the degradation with time of neural functions caused by implant/ tissue mismatches in stiffness, insertion-associated injuries and foreign body reactions represent all serious problems to be overcome. Further on, other complex challenges are to be faced along this route, including the stable sensing of weak signals from individual or a few neurons for long periods, the implementation of microstimulation paths for twoway control of neurons activity, and the embodiment of signal processing capabilities in the implant at low power consumption. Developing new materials, nanoscale devices and architectures allowing for an efficient and smart bi-directional interfacing of microelectronic devices with the nervous tissue and providing a high degree of biocompatibility is therefore key for successful application of neural interfaces.

This Focused Session, that follows the ones on the same subject held at previous CIMTEC Conferences, will feature recent progress in this challenging research field whose breakthroughs are expected to have relevant impact on the treatment of disorders of the nervous system such as e.g. spinal cord injuries, neurovegetative diseases such as e.g. Parkinson's, autism, severe mental illness, and visual cortex and retina diseases.

The following and related subject matter will be covered:

- Neural electrode materials: 1D, 2D nanomaterials, electroactive and optically active materials, bioinspired materials, bioactive hydrogels ...
- Conformable and flexible electronics for neural interfacing
- Nano-, microdevices for neural signals processing
- Axon pathfinding to target, neural tissue engineering, bioactive scaffolds for nerve regeneration
- Biocompatibility of neural electrodes with tissue, neuroprosthetic device biostability
- Substrate micro-nano structuring and functionalization for neural development
- Thin film-based technologies for neuroprosthetics
- Deep-brain and peripheral neural electrode interfacing
- Mechanical and electronic properties of implantable neural recording and stimulation devices

- In-vitro neural interfacing studies; lab-on-chip devices
- In-vivo studies: systemic response (physical, chemical, electrical) to implanted neural interfaces
- Signal quality, signal management, reliability, long term stability.
- Updated achievements in clinical translations e.g. treatment of neurodegenerative diseases, brain injuries, epilepsy, spinal cord injuries, artificial retina,

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Focused Session FQ-7 Wireless Body Sensor Networks for Healthcare Applications

Wearable communications and personal health management are the future trends the healthcare procedures are nowadays heading for. To make this happen, new technologies are required to provide trustable measuring and communications mechanisms from the data source to medical health databases.

Indeed, fuelled by the rapid growth in physiological communication microfluidics, wireless sensors, capabilities, and developments in materials chemistry and rapid prototyping/3D printing, new generation wearable and implantable body sensor technologies are emerging, driven by demand across a broad range of civilian and military applications. Of primary interest for this technology is personal health and healthcare applications, especially those requiring continuous monitoring of vital parameters of people suffering from chronic diseases. However, despite the advances in wireless BSNs and monitoring devices, further progress is needed in system integration, sensor miniaturisation, long-term reliability, autonomous operation, context aware operation, and data transmission and signal processing, for BSNs to become a truly pervasive technology that is compliant with non-technical legal, regulatory and ethical constraints.

Following the symposia on the same topic held at



previous CIMTEC Conferences, the aim is to bring together researchers and engineers of academia and industry from multiple disciplines to address and debate these complex technical and regulatory challenges.

Session topics:

Advances in sensing devices for biomedical monitoring Smart fabrics and wearable patches

Integration of wearable/implantable sensors

Low power electronics, energy management and harvesting, interconnects, antennas

Body sensors network architecture

Impact of advances in materials chemistry/biology and rapid prototyping/3D printing additive fabrication technologies

Applications in personalized healthcare and personal health monitoring

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Focused Session FQ-8* 3D Bioprinting of Soft Tissues and Organs

Three-dimensional bioprinting in medicine advanced considerably over the last few years due to the high precision control of scaffold architecture, increased material versatility, easy process automation and product customization. The multi-material and multiscale combination of living cells with a broad range of novel synthetic and natural biomaterials coupled with improved 3D bioprinting tools is now enabling the fabrication of accurately engineered three dimensional tissues constructs with tailored properties and functions in terms of biological performance and anatomical fit.

Scope of this symposium is to discuss the current state and prospects for refined and new 3D bioprinting technologies capable to create building blocks for complex biological systems and for the development of 3D in vitro system for drug testing and personalised, including most recent advances in image-based computational design, advanced imaging system, design and fabrication of micro and millifluidic bioreactors, innovative bioinks and biofabrication software and hardware. Reports on translation activities for pre-clinical and clinical applications will be also focus of discussion.

Session topics:

Bioinks (biomaterials and cell-based) Advances in imaging techniques, CAD/CAM software and hardware

* Joint session with Session FA-5 of Symposium FA

Printed materials characterization and process control On-chip applications Tissue and organ printing and post processing Novel 3D tissue scaffold fabrication

Modelling of bio-fabrication process and bio-fabrication constructs

In-vivo testing and translation to the clinic Micro and milli fluidic bioreactors

Progress in 3D biofabrication techniques

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FR - 4th International Conference **Materials Challenges** for Sustainable Nuclear **Fission and Fusion Technologies**

Advanced programs are being pursued by several countries on nuclear technologies to assure a safer, reliable, environmentally sustainable, and economical energy. In this context, materials have to be available that embody refined structural, functional and radiation endurance needed to fulfil today technologies requirements and to face future demands that would come from perspective new generation fission and fusion reactors now at the design or at the DEMO stage.

This International Conference, which follows the ones on the same subject held in the frames of CIMTEC 2010, 2014 and 2018, will cover: i- processing, properties, modelling and simulation of nuclear fuels and of structural and functional materials for fission and fusion reactors; ii- radiation damage processes and characterization of irradiated materials; and iiibehaviour of materials during severe accident.

Materials related aspects in component design, crosscutting materials issues and medium and long-term targets for nuclear

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fission and fusion systems will be relevant to the debate as well as the crucial problem of radioactive nuclear waste management that will be object of a parallel Focused Session.

Contributions are solicited in the following and related areas:

FR-1 Structural components for nuclear fission and fusion applications

- High-temperature metallic alloys and superalloys
- Metal-matrix composites
- Oxide-based and non-oxide-based ceramics
- Ceramic-matrix composites

FR-2 Low activation structural materials for nuclear fusion systems

- Ferritic and martensitic alloys
- Vanadium alloys
- SiC and SiC matrix composites

FR-3 Materials for first wall components of nuclear fusion systems

- Plasma facing materials
- Blanket materials

FR-4 Functional materials

- Insulators
- Superconducting magnets
- Coatings

FR-5 Nuclear fuel materials

- Processing, microstructure, and properties relationship
 - Oxide-based nuclear fuels
 - Non-oxide-based nuclear fuels
 - Metal-based nuclear fuels
 - Thermomechanical modelling
 - Recycle of nuclear fuels
 - Advanced fuel cladding materials and coatings
 - Materials behaviour in accidental conditions

FR-6 Radiation effects

- Defect production and properties
- Microstructure evolution
- Mechanical property changes
- He and H effects
- Theoretical modelling

FR-7 Materials modelling and database

- Modelling of performance
- System design and modelling
- Materials and mechanical properties database

FR-8 Crosscutting materials issues, present status, challenges and directions for nuclear fission and fusion science and technology



Focused Session FR-10 Materials Issues in Radioactive Nuclear Waste Treatment and Disposal

This session will focus on the treatment and disposal of low and high level nuclear wastes from commercial power generation, fuel reprocessing, and defense operations. Technologies for interim, short-term, and long-term storage and disposal are of interest, including mature processes as well as new and innovative technologies. The goal of the session will be to identify and provide solutions to materials issues in the global integration of waste treatment technologies.

Session Topics

- FR-10.1 Waste form development, including glass, ceramic, cement and metallic waste forms
- FR-10.2 Challenging waste constituents, such as actinides, noble metals, and volatile species

- FR-10.3 Waste form modeling, performance testing, and advanced characterization techniques
- FR-10.4 Materials issues in the design and operation of waste immobilization facilities

International Advisory Board

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INFORMATION TO AUTHORS & PARTICIPANTS

Venue

Montecatini Terme is an internationally renown Spa and tourist resort in the environments of Florence, the historical centre of the European Renaissance. The town is placed in a strategic position to reach the most renowned historical and tourist places in Tuscany, such as Florence, Pisa, Siena, Pistoia, "Le Cinque Terre (Five Lands)", and several others.

The congress will be held at the Palazzo dei Congressi, located in the heart of Montecatini Terme, within walking distance from the hotels.

Due to the need for a very large number of parallel sessions, some Symposia will be held in ancillary meeting rooms, very close to the Palazzo dei Congressi (2-4 min walking distance).

Scientific Programme

The scientific programme will consist of Plenary, Keynote, Invited Lectures and Oral and Poster contributions. English will be the official language of the conference.

Abstract Submission

Abstracts have to be submitted on-line by the *Presenting Author* and prepared according to the on-line Abstract Instructions available at the Conference web site:

www.cimtec-congress.org

Electronic submission ends on **October 15, 2021**.

Acceptance notification will be provided by December 15, 2021. Multiple abstracts from the same *Presenting Author* are not accepted, in order to open opportunities for the broadest possible participation. Abstracts of previously unpublished matter shall only be submitted.

Abstracts of all scheduled oral and poster presentations will be made available on the conference web site to all registered participants at least 15 days in advance of the Conference.

Presentation Formats

Oral Presentations

Electronic presentation (Power Point) facilities will be available including LCD high resolution projector and PC. Cost for any special audio-visual request will be the responsibility of the individual speaker.

Poster Presentations

Authors are kindly asked to follow carefully the guidelines for Poster Preparation available at the conference web site. Attendance by at least one of the authors is requested for poster presentation.

Publication Policy

Contributions presented at CIMTEC 2022 may be submitted for publication in a Special Proceedings issue of the high-rated journal Ceramics International. Details will be given in the Final Announcement.

Social Programme

The Social Programme will include various social activities. Details will be given in the Final Announcement.



Companions Programme

Guided visits to Florence, Pisa, Siena and other places of high historic, artistic and tourist interest will be available to companions. Detailed programme and registration information will be provided in the Final Announcement.

Provisional Registration

Prospective participants are kindly requested to **Pre-register** at CIMTEC 2022 website.

Presenting Authors shall not Pre-Register as they are automatically filed when submitting the Abstract.

The Final Announcement including the Provisional Programme and the information concerning registration and hotel booking will be available by February 15, 2022.

Registration Fees

Early (by April 30, 2022)	Ceramics Congress	Forum
Full Member	740.00 EUR	740.00 EUR
Student	410.00 EUR	410.00 EUR
After April 30 and On site)	
Eull Mombor	940 00 ELID	940 00 ELID

Full Member840.00 EUR840.00 EURStudent480.00 EUR480.00 EURThe fees include VAT, general and secretariat costs, participation

in the scientific sessions, coffees, printed booklet of the final programme, conference material and participation in the Social Programme.

Accommodation

Hotels for all pockets are available in Montecatini Terme. Half Board (HB) prices range from about 50 EUR/day for two-stars hotels to about 170.00 EUR/day for five-stars luxury hotels. Further information and hotel booking forms will be provided with the final announcement and in the web.

Weather

The weather in Montecatini Terme in June is usually fine with temperatures ranging from 18 to 28 $^{\circ}$ C during the day and 15 to 18 $^{\circ}$ C during the night.

INFORMATION TO AUTHORS & PARTICIPANTS

Visa Application

All travel, lodging and registration expenses will be the responsibility of the individual participants. Special letters of invitation to be used for Visa application will be provided upon written request addressed well in advance to the Conference organizers, congress@technagroup.it including the following information: date of birth, place of birth, nationality, title (Ms., Mr., Dr., Prof.), affiliation, full postal address, passport number, issue and expiring dates of the passport.

How to reach Montecatini Terme

By plane:

To Florence International Airport "Amerigo Vespucci" To Pisa International Airport "Galileo Galilei".

A complimentary bus transfer service will be arranged for CIMTEC attendees from both the Florence and Pisa Airports to Montecatini Terme on Monday June 20 and Saturday June 25 (i.e. the arrival days for the Ceramics Congress and the Forum on New Materials, respectively) with departure from 2.00 p.m. to 12.00 p.m. CIMTEC reception hostesses will be available at the exit of arrivals terminal on June 20 and June 25 (2.00 p.m to 12.00 p.m.) to assist delegates.

By train:

From Florence: train connections to Montecatini Terme are excellent and very frequent (every hour). Travel time from the Florence Central Railway Station to Montecatini Terme railway station (Montecatini Centro) is about 50 minutes .

From Pisa: line Pisa-Lucca, then line Lucca-Montecatini Centro. Travelling time from the Pisa Airport or downtown Pisa railway station to Montecatini Terme (via Lucca) is about 90 minutes.

By car:

Montecatini Terme can be reached easily by car from any direction via the network of Italian highways. The exit to Montecatini Terme is located midway between Florence and Pisa on the Firenze-Pisa (Florence-Pisa) express-way which is connected directly with the Central Italian expressway the "Autostrada del Sole" ("Sun Highway").

SUMMARY OF DEADLINES

October 15, 2021 Submission of Abstract

December 15, 2021 Notification of Abstract acceptance

> **April 30, 2022** Registration at reduced rate

INFORMATION AND CORRESPONDENCE

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A selection of endorsing and cooperating bodies of CIMTEC Conferences

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