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Conference Chairs:
Corrado Spinella (Dipartimento di Scienze Fisiche e Tecnologie della Materia - CNR)
Maurizio Peruzzini (Dipartimento di Scienze Chimiche e Tecnologie dei Materiali - CNR)

Italian National Conference on Materials Science and Technology

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Corrado Spinella (DSFTM - CNR)

Maurizio Peruzzini (DSCTM - CNR)

BOOK OF ABSTRACT

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#P003 - Statistical inference for image reconstruction through multimode fibers

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One of the biggest challenge in the field of biomedical imaging is the comprehension and the exploitation of the photon scattering through disordered media: Many studies have pursued the solution of this riddle achieving light-focusing control or for reconstructing images in complex media. In the present work, we investigate how statistical inference could help the calculation of the transmission matrix in a multimode fiber, thus enabling its usage as a normal optical element. Our desired goal is to uncover insights from the scattering problem, encouraging the development of novel imaging techniques for better medical investigations.

#P004 - Creep characterization of a nickel-based superalloy for sCO2 turbomachinery for green power generation

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Thermodynamic cycles using CO_2 in supercritical conditions (sCO_2) can provide many advantages for future power generation applications. Thanks to the high fluid density, sCO_2 causes a significant machinery size reduction, along with the possibility to achieve very good efficiencies. Due to thermal stability and non-flammability of sCO_2, direct heat exchange from a wide range of thermal sources is possible from relatively low to very high temperatures. This makes sCO_2 suitable for micro-channel-based heat exchanger technology in close-loop systems in combination with thermal solar power (CSP), biomass, flaring, nuclear and even geothermal sources. However, with sCO_2material selection and design problems can raise, since materials must have resistance to high-temperature oxidation, corrosion and deformation under constant mechanical loading (creep resistance), so nickel-based superalloys for turbo-machinery components, and austenitic and ferritic stainless steels for piping should be used in sCO_2cycles.

Exergy S.p.A. is focused to develop a new turbo-machinery for sCO_2 in close-loop systems for direct heat exchange from green thermal sources, and in ICMATE Milan the nickel-base superalloy A286 that is widely used in aerospace applications, has been investigated through simulating the operational conditions of temperatures (560-720°C) and mechanical loadings (200-560 MPa) typical of sCO_2 close-loop systems in order to test the alloy feasibility to be used in turbo-machinery components like shafts. Different production routes were also imposed to A286 by changing heat treatments and deformation conditions prior creep testing to find the optimal response of the alloy to the operational conditions. Results concerning the mechanical response and the microstructure evolution of A286 under creep conditions are reported.

#P005 - Data-Matrix techology for quantitative Multiparameter Monitoring of Cell Cultures

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Cells can be used as efficient sensors exploiting their change upon external/internal stimuli morphology, shape, immunofluorescence and so on. Moreover, cell cultures are one of the most powerful activity for the initial stage of a variety of application in life science, ranging from the mono-cellular level study to complex multicellular tissue and regenerative medicine. The number of cells adhered on a substrate, their morphology, spatial distribution and the capacity to migrate are widely used information to establish cell wellness and as a first order characterization the differentiation stage. We developed a new method, in which we addressed the problem of multiparameter monitoring of cell cultures by introducing the data-matrix technology in cell biology as an efficient method for facile, real time, multi-parameter monitoring of cell cultures. The method exploits the know-how developed for error handling in digital information technology developed for satellite communications and used for data-matrix technology. The method is based on the measure of reading errors induced by intervening cells upon checking a fluorescent data-matrix code placed behind them. By reading fluorescence images via a modified data-matrix reader of a smart-phone, the method delivers number of fluorescent cells, coverage and time evolution. The process has been demonstrated with several immunostained model cell cultures as well as by monitoring the evolution in time of green fluorescent protein in a fibroblast culture and for cell sorting.

#P006 - Thermal kinetic of TPA+ release and structural changes of ZSM-5 combining an "in situ" time-resolved synchrotron powder diffraction study and ex-situ thermal analysis

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The study of the zeolite behaviour upon heating and their consequent structural modi fications is of particular importance since catalytic properties, molecular sieve effects are remarkably enhanced in the dehydrated/calcined state and at relatively high temperature. The structural modifications occurring in the zeolite framework are affected by several intrinsic chemical and structural factors (*i.e.*, framework topology, Si/Al ratio, charge-compensating cations, coordination of bare cations, crystal size, heating rate, etc.) [1-3]. In this work, the structural modifications of a ZSM-5 zeolite with Si/Al ratio (SAR) of 51, as a consequence of the degradation of the template, tetrapropylammonium ion (TPA+) and the release of water molecules upon heating, in the range between 25 and 800 ° C, has been studied combining an *in situ* synchrotron radiation powder diffraction and ex-situ thermogravimetric analysis The time-resolved experiment, performed at the MCX beamline at Elettra allowed to monitor through structure Rietveld refinements the evolution of the lattice parameters and the occupancy variation of the TPA+ and water molecules up to 800 °C. High temperature experiments confirm that the ZSM-5 maintains its crystallinity and its symmetry (*i.e.*, orthorhombic, s.g. *Pnma*) within the investigated T-range. In particular the inspection of the Fourier map at Room Temperature, located the TPA + at the intersection of the straight and sinusoidal channel, according to the literature [4]. The analysis of bonding distances has shown that the template does not interact with the framework oxygens, but only with the water molecules, also located in the intersection of the channels, through hydrogen bonds. The *in situ* and ex situ techniques showed a similar total weight loss (14 and 15 %, respectively), but indicated a different temperature and kinetics of TPA+ and water release (400 and 510 °C, respectively). Specifically, the cell parameters constantly increase with the temperature up to 200 ° C, as a consequence of the increase of the CFA and the partial disordering of the water molecules inside the channels. After 200 °C, when the template degradation and water molecules desorption begin, the thermal expansion becomes negative.

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#P007 - Tuning polymorphism in 2,3-thienoimide capped oligothiophene based field-effect transistors by implementing vacuum and solution deposition methods

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We investigated the impact of the molecular packing and film morphology on the field-effect charge mobility in 2,3-thienoimide-based oligothiophenes semiconductors (Cn-NT4N). Organic field-effect transistors were realized by implementing both vacuum and solution methods in order to control the solid-state phase of the active layer. Indeed, controlling the polymorphism of the active layer is an effective strategy for tuning the electrical properties in organic devices. Thermal sublimation in high vacuum chamber and Supersonic Molecular Beam Deposition were used as vacuum-based fabrication approaches while Lithographically Controlled Wetting was used as a solution-deposition technique. Thermal sublimation led to thin-films with a phase packing showing ambipolar behaviour. By tuning the deposition rate, Supersonic Molecular Beam Deposition enabled the formation of two crystal phases showing different electrical behaviour. On the other hand, Lithographically Controlled Wetting allowed the formation of Cn-NT4N microstructured active layers and their implementation in field-effect transistors.

#P008 - Additive Manufacturing of ceramic materials with Filament Extrusion 3D Printing

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Additive manufacturing (AM) is a technology having great potential for the development of sustainable process to produce near-net-shape components. The addition of material, instead of its removal, reduces waste, machining operations, production time of prototypes and allow component design not obtainable with traditional manufacturing processes. Since about three decades, AM technologies have been used for processing of polymeric or metallic materials, in order to fabricate prototypes or models, and new products are now on the market. Similar results are expected from AM of technical ceramics, but ceramic processing is difficult due to the more demanding parameters to obtain the final component: the consolidation requires high temperature sintering and the feedstocks are not easy available on the market. In the Filament Extrusion 3D Printing of ceramics, the feedstock is a paste, with an extrudable composition where the high solid content promote the green density. A crucial stage is the setup of the paste, in order to produce a final object with