AARP - XlabF: Compact Solutions for Future Advanced X-ray Studies

Report of Contributions

https://agenda.infn.it/e/31663

Contribution ID: **5** Type: **not specified**

”Applications of x-rays and optics @XLab Frascati: from Cultural Heritage to materials analysis”

Wednesday, June 22, 2022 10:30 AM (30 minutes)

Presenter: Dr GUGLIELMOTTI, V. (INFN-LNF)

Contribution ID: **6** Type: **not specified**

"Tree-rings as unique natural archives to reconstruct environmental change in time and space"

Wednesday, June 22, 2022 11:00 AM (20 minutes)

Tree rings are unique natural archives, able to record environmental history at different time scales, dating back to hundreds or thousands of years. They are widely used to analyze the impact of climate (or other ecological factors) on growth variability over forest dynamics. Dendrochemistry, i.e. the presence of selected chemicals in tree rings, is a promising field in tree ring science, through which it is possible to infer chemical changes in the environment, as well as their metabolic role in wood formation. In this context, coupling tree ring and wood anatomy methods with X-Ray spectroscopy represent a highly promising tool in assessing long-term global change effects over selected landscapes.

Presenter: Prof. DI FILIPPO, A. (Università della Tuscia)

Contribution ID: **7** Type: **not specified**

"X-ray characterization of ultra thin free-standing doped ceria membrane for green hydrogen"

Wednesday, June 22, 2022 12:00 PM (20 minutes)

Samarium and Gadolinium Doped ceria (SDC-GDC) is one of most promising material for energy conversion and storage. Indeed, CGO is a promising candidate as electrolyte for Solid Oxide Fuel cells (SOFCs) due to its high ionic conductivity. Even more, Ceria-based materials represent a very promising class of electrocatalysts for CO2 reduction in solid oxide electrolysis cells (SOECs) due to their higher stability and efficiency to convert CO2 in CO compared to other Ni-based material [1-2]. Epitaxial SDC thin films synthesized by Pulsed lased deposition (PLD) are deposited onto single crystal SrTiO3 (STO) perovskite substrates. STO substrate not only provide an "ideal"surface atomically flat for epitaxial thin film with low degree of defects but also, it can induce epitaxial strain by lattice mismatch between substrate and film generating a significant variation of the ionic and the transport properties. On the other hand, the commercial application of "devices"based on epitaxial oxides thin films deposited onto single crystal substrates is not convenient due to the high cost of the substrates and the difficulty to integrate in standard chips Silicon based, specially for material for electrochemical devices such as doped ceria that the ionic charge carriers increase the mobility in the temperature range higher than 200℃. For these reasons we need to combine the advantage to deposit films onto single oxide crystal substrate and the possibility to transfer the film on more engineered substrate that can be integrated smart devices. In this work we show the growth mechanism and the structural properties of epitaxial CGO buffered with selective etching of Sr3Al2O6 (SAO) as a hygroscopic oxide sacrificial thin film layer: heterostructure consisting of SDC layer and water-soluble SAO onto perovskite STO single crystal substrate is deposited by PLD, transferred to flexible substrate and finally, transferred onto conductive Si substrates [3]. Thanks to the sacrificial layer SAO we can transfer the CGO film deposited STO single crystal substrate with standard procedure by PLD opening new perspectives for industrial production based on oxide thin films combined with silicon micromachining technologies for new class of SOFC and SOEC devices. [1] Theis L. Skafte et al, Nature Energy 4 (2019), 846-855 [2] Sanna et al, Nature Materials 14 (2015), 500-504 [3] Di Lu et al, Nature Materials 15 (2016) 1255-1260

Presenter: Prof. SANNA, S. (Università di Roma Tor Vergata)

Contribution ID: **8** Type: **not specified**

"Innovative energy projects and related materials analysis"

Wednesday, June 22, 2022 12:20 PM (20 minutes)

The world is changing the energy production, conversion, storage and use systems in order to answer security, environmental and competitive more prerssing challenges. The project BLAZE, GICO, ZEPHYRUS, that I coordinate answer to these challenges and need a advanced materiaals analysis techniques.

Presenter: Prof. BOCCI, E. (Università degli studi Guglielmo Marconi)

Contribution ID: **9** Type: **not specified**

"High temperature conditioning and solid oxide fuel cell: experimental tests and analysis"

Wednesday, June 22, 2022 12:40 PM (20 minutes)

The high-temperature conditioning is also supported by sorbent and catalyst materials downstream in order to capture contaminants and supply a high-quality fuel to the solid oxide fuel cell (SOFC) unit for electricity production. In addition, the suitable working of SOFC unit only allows a low limit of contaminants, for example H2S. Thus, the characterization of materials used during this stage is a required procedure to determine their performance and the effectiveness of each conditioning stage. Based on the framework of the European project BLAZE, the laboratory team of the University Guglielmo Marconi has used different characterization techniques (XRD, BET, SEM/EDX) in order to evaluate the material performance during the high-temperature conditioning stage, which will supply a high-quality fuel to SOFC unit.

Presenter: Dr ZULETA, E. C. (Università degli studi Guglielmo Marconi)

Contribution ID: **10** Type: **not specified**

"DANTE - Digital Pulse Processor for X-ray Spectroscopy" (remotely)

Wednesday, June 22, 2022 2:00 PM (20 minutes)

The talk will be focused on DANTE, a Digital Pulse Processor specifically designed for X-ray spectroscopy. Available in single-channel and eight-channel desktop configuration, DANTE has been designed to match the most demanding requirements and features of Synchrotrons and high-end industrial applications. By coupling DANTE with radiation detectors such SDD, state-of-the-art performance in terms of FWHM and count rates can be reached enabling new achievements in different X-ray applications such as: uXRF, XAS, fast X-ray mapping, PIXE. The main functionalities of DANTE will be presented together with some case study examples.

Presenter: Dr TOCCHIO, A. (XGLAB)

Contribution ID: **11** Type: **not specified**

"Single cell level radiobiology at High Brilliance X-Ray Source Laboratory"

Wednesday, June 22, 2022 2:20 PM (20 minutes)

HibiXLab è un laboratorio dell'università di Torino che nasce dall'unione delle competenze del gruppo di Fisica dello Stato Solido nell'impiego fasci di Raggi X e l'opportunità di finanziamento offerta dalla Regione Piemonte, l'università di Torino e l'INFN. Questo laboratorio ambisce ad essere una facility unica nel panorama italiano volta alla caratterizzazione e all'irraggiamento di materiali, sistemi cellulari e dispositivi (es sensori) sfruttando appieno le potenzialità della sorgente di Raggi X Metal-Jet, tecnologia che garantisce tra le più alte brillanze per sistemi table-top. Una volta completato il suo allestimento sarà possibile acquisire simultaneamente mappe di fluorescenza e diffrazione con risoluzione spaziale micrometrica essendo il fascio di raggi X focalizzato. Sfruttando le potenzialità di questo laboratorio verranno presentati i primi risultati ottenuti nello studio dell'effetto di raggi X in vitro sull'esocitosi di neurotrasmettitori da parte della linea cellulare PC12 e di potenziali d'azione generati da neuroni dopaminergici. Queste misure dimostrano come la radiazione ionizzante ha un effetto immediato nel potenziamento nella generazione spontanea dei segnali chimici ed elettrici. —– * —– * —– * —– * —– * —– * —– * —– * —– * —– * —– * —– * —– * —– * HibiXLab is a laboratory of the University of Turin that was born from the union of the skills of the Solid State Physics group in the use of X-ray beams and the funding opportunity offered by the Piedmont Region, the Compagnia di San Paolo and INFN. This laboratory aims to be a unique facility in the Italian panorama aimed at the characterization and irradiation of materials, cellular systems and devices (e.g. sensors) by fully exploiting the potential of the Metal-Jet X-ray source, a technology that guarantees one of the highest brightness for table-top systems. Once its setup is complete, it will be possible to simultaneously acquire fluorescence and diffraction maps with micrometric spatial resolution since the X-ray beam is focused. Exploiting the potential of this laboratory, the first results obtained in the study of the effect of X-rays in vitro on the exocytosis of neurotransmitters by the PC12 cell line and action potentials generated by dopaminergic neurons will be presented. These measurements demonstrate how ionizing radiation has an immediate effect on enhancing the spontaneous generation of chemical and electrical signals.

Presenter: Dr PICOLLO, F. (Università di Torino - INFN sez. di Torino)

Contribution ID: **12** Type: **not specified**

”Life in space project: Fungal growth ability and ultrastructural damage after growth in hypersaline substrata”

Wednesday, June 22, 2022 2:40 PM (20 minutes)

Over the years, the presence of perchlorate salts has been detected on the Martian surface. Perchlorates may have been formed by ultraviolet activity on chlorine compounds left behind, for example, by ancient seas or lakes. These salts are derived from the union of a chemical element (Na, Ca, Mg and K) to a group of atoms consisting of 4 oxygen atoms bonded to a chlorine atom. Notably, the presence of these compounds may contribute to the formation of stable brines on the Martian surface, where liquid water may be stored. From an astrobiological point of view, the possible occurrence of salt water on the planet may increase the likelihood to find hypothetical Martian microorganisms. However, high concentrations of perchlorates are toxic for most of known organisms. Despite that, some microorganisms, thanks to their adaptation to harsh environmental conditions, may exhibit extraordinary resistance to the extreme factors described on Mars, such as high perchlorate concentrations. In this regard, the Life in space project has been established with the aim of evaluating the responses of several selected microorganisms to the exposure to relevant space conditions, among which the presence of perchlorates. In the present work, which is part of the Life in space project, the survival of the Antarctic cryptoendolythic black fungus Cryomyces antarcticus on growth media containing perchlorate salts was evaluated. Our results show an extraordinary resistance of the micro-organism in terms of maintaining growth capacity and structural integrity up to the highest concentrations, thus extending the limits of fungal resistance to the presence of perchlorate salts. Furthermore, this work gives new insights into the possibility of finding terrestrial-type life forms on Mars.

Presenter: Mrs MARTELLA, M.C. (Università della Tuscia, INFN-LNF)

Contribution ID: **13** Type: **not specified**

"Development and characterization of novel optics for focusing X-rays"

Wednesday, June 22, 2022 3:00 PM (20 minutes)

Presenter: Dr EBRAHIMPOUR, Z. (INFN-LNF)

Contribution ID: **14** Type: **not specified**

”Volumetric reconstruction of color center distributions in X-ray irradiated LiF crystals obtained by confocal spectro-microscopy techniques” (remotely)

Wednesday, June 22, 2022 3:20 PM (20 minutes)

Volumetric reconstruction of color center distributions in X-ray irradiated LiF crystals obtained by confocal spectro-microscopy techniques. F. Bonfigli1, S. Botti1, R.M. Montereali1, E. Nichelatti2, V. Nigro1, M. Piccinini1, M.A.Vincenti1, A. Cecilia3 1 ENEA C.R. Frascati, Fusion and Technologies for Nuclear Safety and Security Dep., Photonics Micro- and Nano-structures Laboratory, FSN-TECFIS-MNF,V. E. Fermi, 45, 00044 Frascati (Rome), Italy 2 ENEA C.R.Casaccia, Fusion and Technologies for Safety and Security Department, Photonics Micro-and Nano-structures Laboratory, FSN-TECFIS-MNF, V. Anguillarese 301, 00123 S.Maria di Galeria, Rome, Italy 3 Institute for Photon Science and Synchrotron Radiation, Karlsruhe Institute of Technology (KIT), Karlsruhe, Germany Lithium fluoride (LiF)-based detectors represent a versatile tool for X-ray imaging and for characterization of X-ray beams and optics. These detectors have been used with several X-ray sources, such as compact sources [1, 2, 3], large-scale facilities [4] and for X-FEL beam monitoring [5, 6]. Among the peculiarities of LiF-based detectors, noteworthy ones are their very high intrinsic spatial resolution across a large field of view, wide dynamic range and versatility. LiF detectors are based on radiation-induced color centers (CCs) locally produced by X-rays. The penetration depth of X-rays produces CC volumetric distributions in LiF crystals. We report 3D reconstructions of X-ray-induced CC volumetric distributions in LiF crystals performed by confocal spectro-microscopy techniques: fluorescence microscopy and Raman micro-spectroscopy. The investigated LiF crystals were irradiated with monochromatic X-rays (8 e 16 keV) at KIT synchrotron light source (Karlsruhe, Germany) and with the broadband white beam spectrum of the synchrotron bending magnet.The combination of capability of a LiF crystal to register volumetric X-ray mapping with the optical sectioning operations of the confocal techniques has allowed to obtain 3D reconstructions of the X-ray colored volumes [7], providing promising results for 3D X-ray detection advanced tools. [1] D. Hampai et al, NIMA 720, 113-115, (2013). [2] S. Almaviva et al, Appl. Phys. Lett. 89, 054102-1-3, (2006). [3] G. Baldacchini et al, Review Scientific Instrument 76 (1), 113104-1-12, (2005). [4] F. Bonfigli et al, Radiation Measurements 56, 277-280, (2013). [5] F. Bonfigli et al, Il Nuovo Cimento 42 C 237, 1-8, (2019). [6] F. Bonfigli et al, Proc. of SPIE Vol. 11035, Optics Damage and Materials Processing by EUV/X-ray Radiation VII, edited by Libor Juha, Saša Bajt, Stéphane Guizard 110350N-1,11 (2019). [7] F. Bonfigli et al, Condens. Matter 6, 37, (2021).

Presenter: Dr BONFIGLI, F. (ENEA Frascati)

Contribution ID: **15** Type: **not specified**

"Multifunctional advanced (bio)materials for applications in the biomedical, environmental and food sectors " (remotely)

Wednesday, June 22, 2022 4:10 PM (20 minutes)

Biomaterials are gaining a lot of interest not only in the biomedical field but also in other sectors, such as for environmental and food applciations, in order to provide ecosustainable alternatives to the commonly used not biodegradable materials. They can be processed in different shapes, e.g., particles, spheres, fibers and properly tailored in order to provide specific functionalites. In this framework, the (Bio)Materials Science and Technology Group of the University fo Rome "Niccolò Cusano"is involved in the following research activities: a) the formulation, production and characterisation of innovative, ecosustainable, multifunctional and biomimetic films, fibrous membranes, nanoparticles [1] and spheres for tissue engineering/regenerative medicine, cell encapsulation [2] and drug delivery [3] applications, by means of wet methods, emulsion process and electrospinning technique [4,5]; b) the design and realization of innovative scaffolds and devices for biomedical applications, particularly in the cranio- and maxillofacial sector, through additive manufacturing techniques; c) the production of compostable composites films and spheres for the food packaging [6], for the beverages clarification [7] and for the food fermentation; d) the reprocessing and re-use of agro-food waste byproducts and extracts, in a circular economy and zero-waste vision, for the formulation and development of multifunctional systems, in order to provide improved mechanical, thermal, biological, antioxidant and antimicrobial properties [6,8]; e) the production of protective, antifouling, anticorrosion, photocatalytic, biomimetic and osteoconductive coatings by different techniques e.g., dip-coating, aerography, ⋯) [9]; f) the functionalisation of the material surface in order to improve specific properties, for example to provide antimicrobial, antioxidant and osteoconduvtive properties. The obtained systems are fully characterized in terms of microstructural, thermal, and mechanical and biological properties. References [1] Cacciotti I, Journal of Applied Ceramic Technology 6 (2019)):1864–1884 [2] Cacciotti I et al., Materials Science and Engineering C 2017; 81: 32–38. [3] Cacciotti I et al., Nanotechnology 2018;29[28]: 285101 (11pp). [4] D'Angelo F, Armentano I, Cacciotti I et al., Biomacromolecules 2012;13[5]: 1350-1360. [5] Cacciotti I et al., Carbohydrate Polymers 2014;103:22-31. [6] Cacciotti I et al., Intern J Biolog Macromolecules 112 (2018): 567-575. [7] Cacciotti I et al., Journal of Materials Research and Technology 8[4] (2019): 3644-3652. [8] Cacciotti I et al., International Journal of Molecular Sciences 19(8) (2018): 2368. [9] Materials Chemistry and Physics 146[3] (2014): 240-252.

Presenter: Prof. CACCIOTTI, I. (Università degli Studi N. Cusano)

Contribution ID: **16** Type: **not specified**

”Colour characterisation of a painted Japanese emakimono”

Wednesday, June 22, 2022 4:30 PM (20 minutes)

In the restoration of painted artworks, the colour characterisation is a fundamental analysis to address the choice of suitable materials for the restoration and the consolidation of the painting layers. In this paper, we present a diagnostic study on a unique Japanese painted paper handscroll (emakimono), dated back between the late Edo (1603-1867) and the early Meiji (1868-1912) periods, preserved at the Museum of the Civilisation- Prehistoric Ethnographic Museum “Luigi Pigorini”in Rome (Italy). The artwork required an urgent restoration, from the cleaning up to the consolidation of the entire structures. In order to identify the most appropriate materials for the consolidation intervention of both pigments and support, non-destructive FORS and XRF measurements were carried out on the artefact. The results allowed the identification of the colour palette used for tests on the chromaticity and the efficacy of the proper consolidants to employ in the final restoration.

Presenter: Dr CECCARELLI, S. (Università di Roma Tor Vergata)

Contribution ID: **17** Type: **not specified**

”Peltuinum: la città romana e i campi interdisciplinari”

Wednesday, June 22, 2022 11:20 AM (20 minutes)

Peltuinum è una città romana dell’Appennino aquilano. La sua storia è legata ai terremoti di questa regione fortemente sismica e termina infatti come realtà urbana in seguito ai sismi registrati nel V sec. dC. L’area continua tuttavia ad essere abitata attraverso nuclei sparsi. Il contributo di altre specifiche competenze alla ricerca sulla città si rivela indispensabile per affrontare a 360 gradi lo sviluppo di una società.

Presenter: Prof. MIGLIORATI, L. (Università di Roma Sapienza)

Contribution ID: **28** Type: **not specified**

”Advances in X-ray Fluorescence Spectromicroscopy at TwinMic beamline in Elettra” (remotely)

Wednesday, June 22, 2022 4:50 PM (20 minutes)

Presenter: Dr GIANNONCELLI, A. (Elettra - Sincrotrone Trieste)

Contribution ID: **32** Type: **not specified**

Welcome to participants

Wednesday, June 22, 2022 9:30 AM (10 minutes)

Presenters: Dr HAMPAI, D. (INFN-LNF); Dr GUGLIELMOTTI, V. (INFN-LNF)

Contribution ID: **33** Type: **not specified**

"Opening - Introductory talk on the subject and history"

Wednesday, June 22, 2022 9:40 AM (20 minutes)

Presenter: Prof. DABAGOV, S. B. (INFN-LNF)

Contribution ID: **34** Type: **not specified**

”XlabF - an Italian X-ray Reference Point”

Wednesday, June 22, 2022 10:00 AM (30 minutes)

Presenter: Dr HAMPAI, D. (INFN-LNF)

Contribution ID: **36** Type: **not specified**

Closing remarks

Wednesday, June 22, 2022 5:10 PM (20 minutes)

Presenters: Dr HAMPAI, D. (INFN-LNF); Dr GUGLIELMOTTI, V. (INFN-LNF)