Tuesday, September 17, 2pm-4pm, IEM Conference Room

Sample environments for *in situ, in vivo,* and *operando* experiments at the Carnaúba beamline

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In situ, in vivo, and *operando* experiments at Carnaúba provide valuable nanoscale insights into the behavior of materials and systems under realistic conditions [1]. For this purpose, significant setups involving electrochemistry, microfluidic reactors, battery holders [2-3], heating, and gas systems have been developed and continually upgraded in recent years. These advanced sample environments were designed to leverage not only the small beam (180 x 180 nm² @10 keV) at the Tarumã station but also to exploit its coherent flux through techniques such as ptychography and Bragg coherent diffraction imaging. In the context of applied materials, we have developed miniaturized spectroelectrochemical cells that enable spatially resolved analyses, such as two-dimensional fluorescence and absorption mapping. These tools contribute to the study of charge transfer processes in different regions of a heterogeneous catalyst or battery cathode/anode. For individual nanoparticles, the three-dimensional strain and morphology can be assessed using Bragg coherent diffraction imaging.

References:

[1] Helio C. N. Tolentino, et al., The CARNAÚBA X-ray nanospectroscopy beamline at the Sirius-LNLS synchrotron light source: developments, commissioning, and first science at the TARUMÃ station, J. Electron Spectros. Relat. Phenom. 266 (**2023**) 147340.
[2] Itamar T. Neckel, et al., Development of a sticker sealed microfluidic device for in situ analytical measurements using synchrotron radiation, Sci Rep. 11 (**2021**) 23671.
[3] Rafael Alcides Vicente, et. al., Development of Electrochemical Cells and Their Application for Spatially Resolved Analysis Using a Multitechnique Approach: From Conventional Experiments to X-Ray Nanoprobe Beamlines, Analytical Chemistry 95 (**2023**), 16144-16152.

Itamar Neckel holds a Bachelor's degree in Physics from the Federal University of Paraná (2006), as well as a Master's and a Ph.D. in Materials Engineering and Science from the Federal University of Paraná (2009). He has experience in the field of Condensed Matter Physics, with an emphasis on Materials Engineering, focusing primarily on the growth and characterization of thin magnetic and ferroelectric films. From 07/2015 to 07/2016 he joined the measurement and sensor technology group at the TU Chemnitz, working under the supervision of Prof. Christian Muller. Currently, as a beamline scientist at the Carnaúba beamline of Sirius, he works on the development of instrumentation for *in situ* and *operando* experiments in the sample environment of the Tarumã end-station. The main focus of this work is the in-situ characterization of smart materials using multi-technique X-ray methods, such as nano-fluorescence, nano-diffraction, nano-absorption, and Bragg Coherent diffraction imaging (BCDI).