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The GEMS-N Instrumental Suite and its Potential for the Characterization of Energy Related Material

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The MLZ outstation of the German Engineering Materials Science Center (GEMS) provides an instrumental suite that allows researchers in the field of energy related materials to characterize their systems over several orders of length-scales.

The diffractometer STRESS-SPEC (operated in cooperation with TUM) is a highly configurable instrument which enables spatial and time resolved characterization of the crystalline structures present in bulk samples. [1,2].

The small angle beamline SANS-1 (operated in cooperation with TUM) is a state of the art instrument for the characterization of large scale structures (on the order of 1 - 300 nm) in bulk systems [3,4].

The time of flight reflectometer REFSANS is dedicated to the characterization of surfaces and interfaces. Thanks to a versatile optics and chopper system structures can be detected and measured both in the in and out of plane directions of thin films. These complementary measurements are particularly relevant to the field of electrodes for instance in the case of hybrid solar cells where understanding the detailed structure of the interfaces can help developing new materials and processes leading to improved performance.[5]

Thanks to the high penetration of neutron in most materials the above mentioned complementary methods give access to in-situ and/or in-operando measurements in a non destructive way. In addition to these instruments which are typical of a large scale facility such as MLZ, GEMS also operates on-site the Materials Science Lab which provides access to a wide range of techniques such as optical microscopies, calorimetry, micro hardness tester, and to an excellent x-ray diffractometer equipped with a setup for in-situ battery characterization.

In this contribution we will present how the GEMS portfolio can contribute to a global understanding of structural problems in the field of energy related materials.

[1] C. Kortenbruck, et al. Battery research as progress pacemaker. Neutron News, 26 (1) (2015) 29-32.
[2] V. Zinth, et al. Lithium plating in lithium-ion batteries at sub-ambient temperatures investigated by in situ neutron diffraction. J. Power Sour. 271 (2014) 152-159.
[3] S. Seidlmayer et al., J. Electrochem. Soc. 2015, 162(2), A3116
[4] C. Kortenbruck et al., Neutron News 2015, 26(1), 29
[5] N.Paul, J.Brumbarov, A.Paul, Y.Chen, J.-F.Moulin, P.Müller-Buschbaum, J.Kunze-Liebhäuser, R.Gilles
GISAXS and TOF-GISANS studies on surface and depth morphology of self-organized TiO2 nanotube arrays: model anode material in Li-ion batteries;
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