L-04

First beamline at Solaris

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The first beamline built in the National Synchrotron Radiation Centre Solaris will use bending magnet radiation. The planned beamline is optimized for the soft X-ray photon energy range 200 - 2000 eV. The calculated energy resolving power (E/ΔE) is of the order of 4000 or higher. The chosen optical design based on plane grating monochromator working in the collimated light has been studied by the Elettra group. The results of the optical configuration ray-tracing and energy resolution calculations are presented and discussed. Additionally, detailed explanation of the purpose of each optical element is reported. The dimensions of the focalized beam at the end station, which will host a Photoemission Electron Microscope (PEEM), are 100μm x 50μm. In the future additional refocusing device can be installed to increase the photon flux density on the sample for more demanding experiments.

Within the framework between Jagiellonian University and Jerzy Haber Institute of Catalysis and Surface Chemistry PAS, the Photoemission Electron Microscope will be main end station of the first beamline. The PEEM was successfully tested at the Pollux beamline in the Swiss Light Source. The magnetic contrast was easily seen for the few nanometer thick iron nanostructures. Exchangeable with microscope we foresee to use separate chamber for X-ray absorption spectroscopy measurements. It will be dedicated to biology, chemical, material science and physics experiments. In the future spectroscopy chamber can be adapted to the scanning transmission x-ray microscope chamber by introducing focusing device in front.

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Three-dimensional strain distribution of lithium manganese spinels

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The information regarding the local disruption of the structure is contained in the shapes and breaths of the diffraction profiles and the effects of the microstructure and local atomic environment on X-ray diffraction has been studied extensively experimentally and with numerical simulations [1-3]. During intercalation, the addition of interstitial species causes a change in the unit-cell volume of the lithium-manganese oxides. This leads to strain and stress in the battery system [4]. Stress maps for insertion of lithium into the particle can be plotted.

Synchrotron measurements of the microstrain were performed on ID31 beamline (ESRF). The energy of the monochromatic synchrotron beam was about 30 keV (0.41274 Å wavelength). Rietveld refinements were performed using the program GSAS. Anisotropic peak broadening mainly caused by lattice strain was observed with broadening of the diffraction peaks. The phenomenological microstrain model of Stephens with 4 and 2 refinable parameters for tetragonal and cubic symmetry respectively was used to model the anisotropy in FWHM of the individual peak profiles. This microscopic picture is completed by analyzing the isosurface of the anisotropic microstrain which reflects the strong shear strain of neighboring coordination polyhedra in the lithium manganese structure.

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