

applications of a nanoscope in the set-up of hard X-ray optical data read-out device (e.g. see [1]). Other applications, for example, are envisaged in hard X-ray advanced nanolithography (chip fabrication) and in cell biology to view structural details of living cells in 3D and real time, at a previously unobtainable resolution. A set-up of grazing-angle incidence hard X-ray nanoscope (GIXN) is presented appropriate for the non-destructive high-resolution investigations of the various kinds of non-diffracting subsurface nanosize inclusions based on the grazing-angle incidence X-ray backscattering diffraction (GIXB) technique [2, 3], which takes place in the conditions of specular vacuum wave suppression phenomenon [4]. GIXN analyser is an asymmetrically cut single crystal, which is operating like an image magnifier. High-resolution X-ray diffractive optical lens (zone plate) and spatially resolving detector (CCD camera) are arranged like in classical schemes of the X-ray imaging microscopy.

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Keywords: X-ray imaging, grazing X-ray diffraction, X-ray back reflection

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Application of synchrotron X-ray micro tomographic microscopy at low temperature

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We report the application of synchrotron X-ray cryo-micro tomographic microscopy (SRXCTM) provided by the 'TOMCAT' beam line at the Swiss Light Source (SLS) for studying the substances such as ice and gas hydrate at low temperatures down to 150 K. Description of the precarious handling of the samples within their thermodynamic stabilities, polyamide sample holder, experimental setup, cryo-stage coupled with cooling setup, and data acquisitions were addressed. The monochromatized X-ray beam was modified by a slit system to a profile as small as of 1.4 mm² to confine the irradiation to the region of interest (ROI). The beam energy was optimized to enhance the contrast among the constituents of specimens. The X-ray beams were converted into visible light with a thin scintillator screen. Further magnifications of the projection images were done by microscope optics, which were digitalized using a high resolution CCD camera. Post processing of the reconstructed raw data was carried out using 'MATLAB'. The 3D visualization of the post processed datasets was performed with the software 'Amira' which facilitated to separate the cylindrical ROI from the raw dataset to eliminate the non reconstructed regions. Out of the SRXCTM dataset, both of ice and gas hydrate, parameters like porosity, surface area and volumes were calculated for the whole dataset as well as a single object. The imagery demonstrated the well suited applicability of SRXCTM revealing some salient microscopic features preserved in marine hydrates and atmospheric ice.

Keywords: synchrotron X-ray tomography, ice, gas hydrate

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Imaging and structural analysis of heterogeneous diluted materials by diffraction tomography

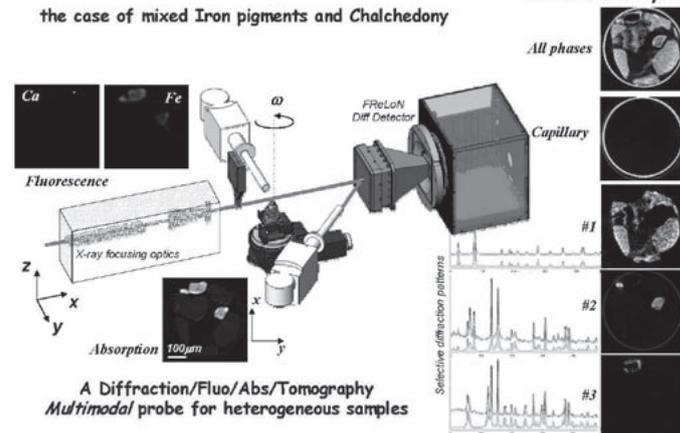
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We evidence the potential of coupling pencil beam tomography with X-ray diffraction to examine unidentified phases in heterogeneous materials and to overpass the relatively low detection limit of X-ray diffraction. The demonstration is performed on a heterogeneous powder containing chalcidony and iron pigments (see figure). Furthermore we will also present the 3D phase selective reconstruction of a high-pressure pellet containing several carbon phases. The present method allows a non-invasive structural refinement with a weight sensitivity of one part per thousand. It allows the extraction of the scattering patterns of the amorphous and crystalline compounds with similar atomic densities and compositions. Furthermore, such a diffraction-tomography experiment can be carried out simultaneously with X-ray fluorescence, Compton, and absorption tomographies, allowing a multi-modal analysis of prime importance in materials science, chemistry, geology, environmental science, medical science, paleontology and cultural heritage [1].

[1] P. Bleuet, E. Welcomme, E. Dooryh e, J. Susini, J-L. Hodeau, P. Walter, *NatureMaterials* (2008) in press, URL: <http://dx.doi.org/>, DOI: 10.1038/nmat2168

Diffraction/Tomography for depth-resolution selective structural analysis & imaging
the case of mixed Iron pigments and Chalcedony



Keywords: diffraction methods, tomography, diffraction imaging of heterogeneous specimens

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Realtime imaging in X-ray fluorescence and X-ray diffraction

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