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 mm^2 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 chalcedony 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].

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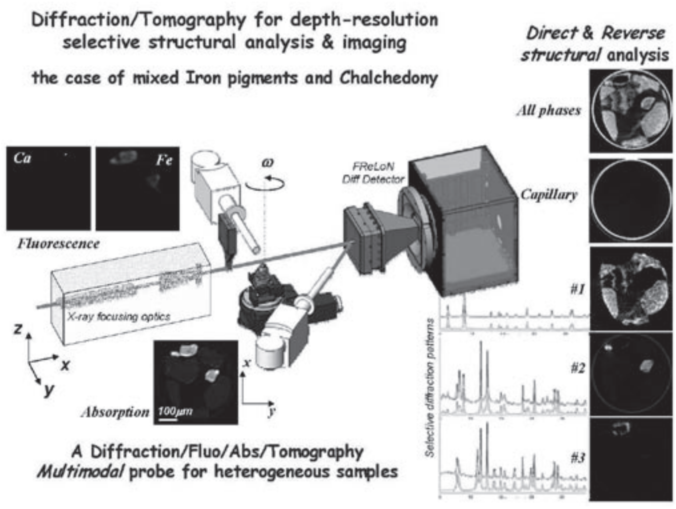

Keywords: diffraction methods, tomography, diffraction imaging of heterogeneous specimens

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

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The present talk describes novel powerful imaging for X-ray fluorescence (XRF) and X-ray diffraction (XRD). So far, the scanning-type imaging has been widely used in those techniques. Though recent progress in high-spatial-resolution imaging using synchrotrons is significant, there have been a clear limit; because of the step-scan, the imaging requires a long measuring time. In many scientific applications, X-ray imaging that are much more rapid, e.g., capable of high-speed resolution have been demanded. It is possible to do X-ray imaging without performing any scans. Here, the method uses quite a wide beam, which illuminates the whole sample surface in a low-angle-incidence arrangement (0.5~3 deg). The detector used is a CCD camera working at 30 fr./sec, equipped with a collimator inside, and the distance between the sample surface and the detector is set extremely close, in order to enhance both spatial resolution and efficiency. Note that the imaging is done with one shot. In the case of XRF imaging, distinguishing elements are required and, therefore, most of the experiments were performed with monochromatic or quasi-monochromatic X-rays. The procedure for XRD imaging uses a combination of exposure and incident X-ray energy scan (or just tuning). Since the present experiment employs a fixed small-angle incidence and also a fixed diffraction angle of around 90 deg, the diffraction plane here is inclined at about 45 deg from the surface of the specimen. By scanning the energy of the incident X-rays, one obtains a diffraction peak, which corresponds to the lattice spacing. Further instrumental details and many applications will be presented.

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Keywords: X-ray imaging, rapid X-ray measurement system, CCD detectors

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Low noise multichannel ASIC for readout of SSD used in diffraction for powder and multilayer samples

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We present 64 channel integrated circuit designed in CMOS 0.35 μm technology for readout of silicon strip detector used in X-ray diffractometry applications. This integrated circuit called DEDIX (Dual Energy Digital Imaging of X-rays) connected to silicon strip detector works in a single photon counting mode and is able to select photons from a given energy window. The main parameters of this ASIC are low noise performance (110 el. rms for Cdet=1pF), high count rate capability (up to 1 Mcps/channel) and very good channel to channel uniformity (effective threshold spread below 7 el. rms). Using the ASICs we have built several 128-channel modules with silicon strip detectors of different strip length (1 or 2 cm) and different strip pitch (50 µm, 75 µm and 100 µm). We have used these modules in diffractometry applications as a replacement of a proportional counter. The measurements were speeded up by over 100 times when using our module. These modules have been tested using different samples, where we compare: results obtained with and without photon selection in a given energy window, the influence of silicon detector strip pitch, measurement, when the module fixed on the diffractometer arm is moving in step or continuously scan mode. We also performed some measurements of multilayer structures, and due to low noise, good uniformity of channels and high rate capability, the measurement time have been significantly reduced without loosing the diffractogram quality.

Keywords: silicon strip detector, integrated circuit, DEDIX

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A new biological neutron diffractometer (iBIX) in J-PARC

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Since 2004, Ibaraki Prefectural Government in Japan has started to construct a TOF neutron diffractometer for biological macromolecules for industrial use at J-PARC, near JRR-3 in JAEA. From December in 2008, Ibaraki University will operate this machine with a support of Ibaraki Prefecture. The diffractometer is designed to cover sample crystals which have their cell edges up to around 150 Å. It is expected to measure more than 100 samples per year if they have $2mm^3$ in crystal volume. The efficiency is more than 100 times larger than the present high performance diffractometers, BIX-4 in JRR-3 reactor in JAEA. To realize this performance, a coupled moderator (intense neutrons, but broad pulse in time resolution) was selected. In addition, two important and key items should be developed; a new detector with high spatial resolution (less than 1mm) and a special software to de-convolute overlapped Bragg reflections in data reduction. The detector uses ZnS:Ag/^{6}LiF scintillator with wavelength-shift-fiber (WLSF) system. The software has been designed using a complicated kind of profile-fitting method. The current status of the construction and developments will be reported.

Keywords: J-PARC, protein crystallography, TOF pulsed neutron diffractometer

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Optimization of design parameters of IBARAKI Biological Crystal Diffractometer (iBIX) in J-PARC

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IBARAKI prefecture in Japan has started to construct the TOF neutron biological diffractometer (IBARAKI Biological Crystal Diffractometer: iBIX) for industrial use at BL03, MLF in J-PARC. The diffractometer is designed to cover the samples have their cell edges up to around 150 angstrom and to achieve the efficiency which is more than 100 times larger than the present high performance diffractometer, BIX-3 (JRR-3, JAEA, Japan) in order to pioneer