

*Séminaire SOLEIL*

## “ X-ray nano-tomography and spectromicroscopy at BESSY II ”

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**Mardi 3 novembre 2009 à 15h00**  
**Grand Amphi SOLEIL**

**Séminaires**

The BESSY x-ray microscopy group developed a new full-field transmission x-ray microscope for automated cryo-tomography and spectroscopy (TXM). The system operates at the undulator U41 at a focusing spherical grating monochromator (FSGM) beamline which provides an energy resolution up to  $10^4$ . For the first time in soft x-ray microscopy, an elliptically shaped single bounce glass capillary is employed as x-ray condenser which collects the divergent radiation emerging from the exit slit of the monochromator and provides the hollow cone illumination of the object area. We measured a focusing efficiency of 80% for this glass capillary condenser. This concept has several advantages, it provides higher flux onto the sample compared to diffractive optical devices, its focus position is photon energy independent, and no pinhole is required close to the sample plane. The spatial resolution of the new microscope is 14 nm.

For high resolution tomography, we adopted a tilt stage originally developed by FEI for electron tomography which supports automated data collection of cryogenic or heated samples. The stage is able to tilt samples in the x-ray microscope up to  $\pm 80^\circ$ . Such a large tilt of flat sample holders is impossible with existing x-ray microscopes at bending magnet sources because these require a monochromator pinhole to be positioned close to the specimen. Therefore, the new BESSY full-field TXM overcomes two main limitations of previous concepts. Firstly, it permits spectromicroscopy with high spectral resolution for NEXAFS studies and short exposure times in the range of one second. Secondly, it overcomes the necessity to load samples into a glass tube holder for 3-D investigations.

Among many scientific questions in life sciences, the cell nucleus which is a vital and complex organelle is still a mystery. How the DNA it contains and its associated proteins are arranged and packaged to fit within this  $\sim 10 \mu\text{m}$  diameter organelle is unknown. Conventional fluorescence microscopy is diffraction-limited  $\sim 140 \text{ nm}$  whereas current x-ray imaging can achieve a ten-fold improvement in resolution, namely 14 nm. Since fluorescence and x-ray microscopy permit analysis of whole cells, it is possible to investigate the same cell in both microscopes. These correlative studies are ideally suited to x-ray microscopy because of its ability to image cells in 3D. We expect that correlative 3D fluorescence and x-ray microscopy, as applied to nuclear structure, will yield significant new insights. In the talk, we present the new TXM and selected applications.

**Formalités d'entrée** : accès libre dans l'amphi du Pavillon d'Accueil. Si la manifestation a lieu dans le Grand Amphi Soleil du Bâtiment Central, merci de vous munir d'une pièce d'identité (à échanger à l'accueil contre un badge d'accès).

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