X-RAY NANOTOMOGRAPHY

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X-ray nanotomography is a nondestructive imaging technique in which the three dimensional structure of the sample is reconstructed from the two dimensional x-ray projection images taken from different angles. The reconstructed image gives a three dimensional map of local attenuation coefficients of the sample.

In nanotomography the x-ray microscope is configured like a typical full field microscope incorporating a source and optics which is composed of a condenser and an objective, so as to achieve a resolution in this case of 50 nm. The resolution of a zone-plate based x-ray microscope is independent of the spot size of the x-ray source, and is ultimately limited by the width of the outermost zone in the objective lens. As a consequence, its resolution is inherently coupled to progress in the fabrication technology of Fresnel zone plates.

Soft (cryogenic) x-ray tomography can generate high-contrast 3D images of intact cells in a near native state now with 50 nm resolution. Using photons with energies between the K shell absorption edges of carbon (284 eV) and oxygen (543 eV), contrast between organic material and water can be maximized for biological samples. For inorganic materials x-rays with higher energies (~8 keV) will provide greater penetrating power and depth of focus, making it possible to image thicker samples with high attenuation coefficients.

Nanometer scale resolution in three dimensional imaging has opened a completely new view in many fields of science. Many structural features of samples like airborne or sedimented particles, bone, compounds of organic fibers and native cells have already been successfully determined and analysed in detail. Examples of these will be given.