

Implementation of a high resolution CCD camera for micro-radiography at beamline L

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A coolview EM 1000 high resolution camera (Photonic Science) has been installed and tested at HASYLAB, beamline L. The X-ray sensitive camera is based on a YAG:Ce thin-film scintillator (20 μm thickness) deposited on a 300 μm thick undoped YAG single crystal substrate which generates visible light when irradiated with X-rays. The visible image from the scintillator is then magnified and imaged by a 10x microscope objective onto a Peltier cooled 1004x1002 CCD chip (8 micron pixel size) with 12 bit digitization, resulting in an effective pixel-size of 0.8 μm and a field-of-view of 800 μm .

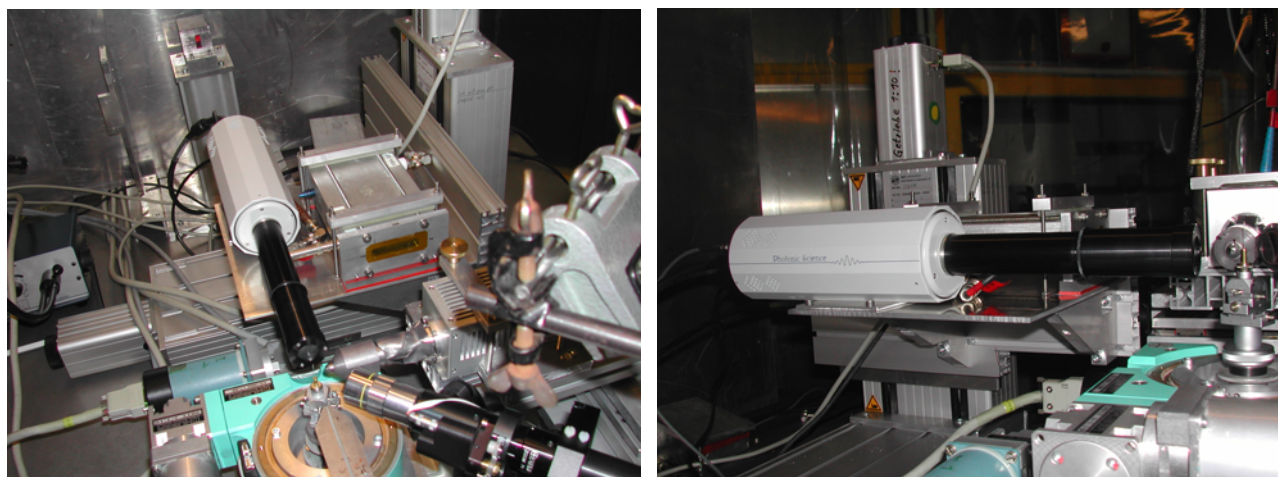


Figure 1: Overview of the experimental set-up at beamline L (left image) and close-up image of the high-resolution X-ray camera (right image).

The camera is based upon a unique CCD image sensor that includes up to approximately 2000 times on-chip amplification of the acquired image signal. Such amplification provides many of the benefits of an image intensified CCD, and allows the CCD to provide usable video images in much lower lighting conditions than conventional CCDs. In addition, this technology has benefits over ICCDs, as the CCD cannot be damaged by overexposure to high light levels, which can occur with image intensified devices. A fully automatic Digital Gain Management System (DGMS) exposure control circuit is used to cope with a large range of input light levels is present. CCD integration period, on-chip amplification and video gain are controlled within a single feedback loop to regulate the video amplitude.

The camera at beamline L is equipped with the easy-to-use Image Pro software which makes operations such as background subtraction, sensitive integration, multi-image capturing and applying enhancement filters convenient. The camera also provides a range of software-selectable imaging modes.

The coolview EM 1000 includes features such as software and hardware triggering (via an RS232 interface). The hardware triggering of the camera has recently been optimised to work with the TTF-triggering signals (sent from the workstation) which control the movement of the different motors at the sample stage. In this way, a synchronised movement of a motor during scans can be coordinated while automatically acquiring images with the camera.

The camera has been mounted on a double motorised stage. The first linear-stage allows the camera to move easily out of the beam and switch quickly with other analysing tools such as the ionisation chamber or a diffraction camera. The second linear-stage allows to move the camera closer to the sample stage.

Next to high-resolution radiography, the camera can be used for sample positioning, for selecting the right area to analyse with the microbeam, and for aligning the microbeam optics. Interesting possibilities to explore in the future are implementing changeable objectives to obtain variable field of view of the camera. The possibility of absorption tomography for which the automatic triggering is an essential step will also be explored. Imaging possibilities of the camera on biological samples are illustrated in Fig. 1 and Fig. 2

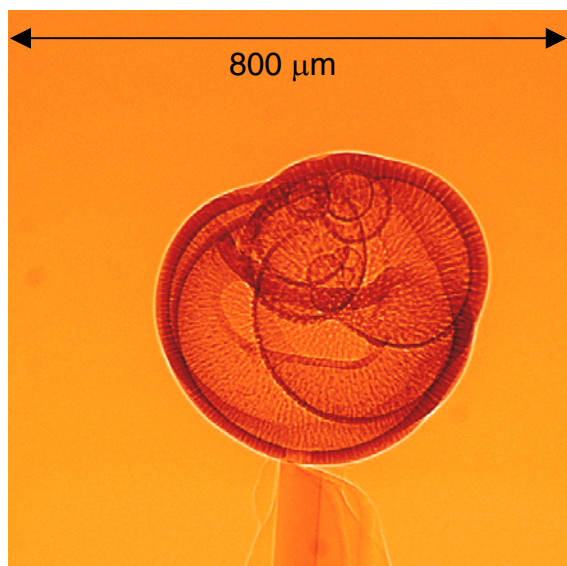


Figure 1 : Foraminifera @ 20keV

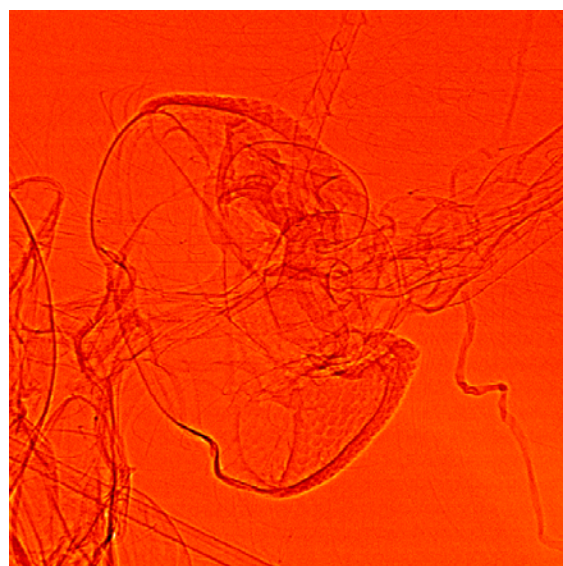


Figure 2 : Mosquito head @ 17keV

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References

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