Microbeam Diffraction using High Energy Synchrotron Radiation

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The possibility of micron and sub-micron X-ray beams at High Energies (50-100keV) has opened up a wealth of new experimental possibilities. At the Materials Science beamline (ID11) of the European Synchrotron Radiation Facility (ESRF) a dedicated instrument, the three dimensional X-ray diffraction microscope (3DXRD), has been developed in collaboration with Risoe National Lab. Beam sizes ranging from 1 mm to 1 micron are available, and the combination of high flux and fast detectors allows for time resolved measurements. A number of examples will be presented to demonstrate the range of possible applications. The focus here will be on materials science applications, although these techniques are applicable to a large range of fields.

Among the applications presented will be the kinetics of recovery of sub-micron cells in highly deformed metals. The technique for constructing 3D maps of the full microstructure of materials (grain boundary morphology, grain orientation, elastic strain tensor) will be described, and a time resolved measurement of nucleation and growth of an imbedded grain within a highly deformed bulk metal will be shown in 4D.

Finally, the potential of achieving micron spatial resolution without micro focusing, that is using large beams, will be discussed with the obvious advantage of greater time resolution. Specifications for the current nanoscope project (an extension of the ID11 beamline due for completion in 2007) will be briefly described.

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