INSTRUMENTATION & TECHNIQUES

The development of new instrumentation and techniques is intrinsic to the scientific process; almost every experimental proposal aims to address and improve upon these tools. Several recent developments at SPring-8, however, are particularly noteworthy for having surpassed prior limits of resolution and quality. Detailed descriptions of six such projects are presented in the following pages.

The energy resolution of the grating monochromator at beamline BL25SU appears to have reached the highest energy resolution yet obtained, using first order diffraction by a 600 grooves/mm grating. This technology has allowed high-flux, high-resolution work in soft X-ray microscopy and photoemission spectroscopy, as well as magnetic circular dichroism. Magnetic domain imaging has been carried out at this high-performance beamline by means of PEEM (photoelectron emission microscopy).

Hard X-ray imaging techniques has been developed as well at beamline BL39XU by using a Wolter mirror to focus fluorescence X-rays. 3-D images have been obtained using computer tomography on some model samples including 3d transition metal wires. An alternative imaging technique using Fresnel zone plates has also been developed at beamline BL47XU, where both high spatial resolution (0.6 μm) and high flux (10^{10} photons/sec) were attained at 27.8 keV. These benchmarks in scanning X-ray microscopy easily surpass those previously obtained at other sites Using high-intensity undulator radiation at beamline BL24XU, a diffraction-limited parallel X-ray beam has been produced with a series of asymmetric reflections while maintaining a reasonable photon flux. This has allowed for observation of very small strain effects at the boundary between the Si and SiO_2/Si regions of a semiconductor device.

Finally, high-energy photons produced by a wiggler at beamline BL08W have been utilized for Compton scattering. The availability of high-energy photons made possible the measurement of Fermi surfaces of materials containing heavy atoms (high-Z materials). These studies were supported by research and development of new detectors and more refined arrangements of analyzer crystals.

Studies in nuclear physics have commenced at SPring-8. Researchers have generated γrays with energies up to 2.4 GeV by Compton back scattering at beamline BL33LEP, using an intense laser as the injected photon beam. Each γphoton is energy-tagged based upon the energy of the electron which collided with an injected laser photon. This accomplishment is expected to generate further interest and developments in nuclear physics.

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