Australian Synchrotron
lighting the path to innovation

Soft X-ray Spectroscopy

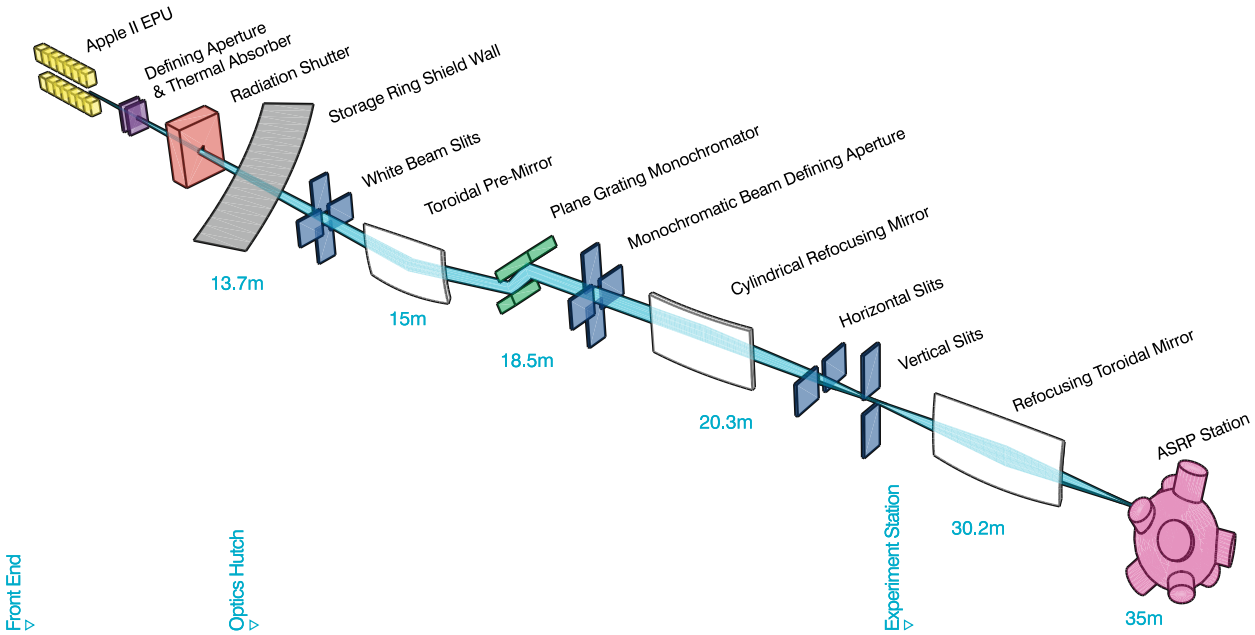
The soft x-ray spectroscopy beamline is mainly set up for x-ray absorption spectroscopy (XAS) (for atomic numbers below 20), and x-ray photoelectron spectroscopy (XPS). It can provide information on bond lengths, coordination numbers, local coordination geometry and the oxidation state of atoms (Z < 20) for a wide range of solid and liquid systems.

Features

- low energy XAS, XES (x-ray emission spectroscopy), XPS and AES (atomic emission spectroscopy)
- photon range (80-2500 eV) encompassing the K edges of C, O, and N at high resolution
- circularly polarised light (100-1000 eV) useful for investigating the L edges of first row transition metals.
- magnetic x-ray circular dichroism (MXCD) can be used to separate the magnetic orbital and spin components of magnetic systems
- photo-desorption and threshold x-ray excited Auger electron spectroscopy (XAES) studies
- elliptically polarised undulator enabling full polarisation control of x-rays
- a wet cell for non-microscopic XAS with silicon nitride windows to enable studies of the carbon K edge near 0.3 keV and the 'water window' between the carbon K edges and the oxygen K edge near 530 eV is planned.

Applications

Synchrotron soft x-ray spectroscopy provides valuable information for research areas ranging from fundamental studies in solid state physics and nanotechnology to applied chemistry problems in catalysis and coal combustion. Soft x-rays are well-suited to characterising surfaces and near-surface interfacial layers. Full polarisation control of x-rays makes it possible to study magnetic materials through magnetic linear and circular dichroism. Wet cell and ultra-high vacuum capabilities will further extend the range of systems that can be investigated.



Examples

- investigation of the surface chemistry of metal sulfides associated with various stages in the separation of ore components, hydrometallurgical processing of concentrates, and leaching of waste heaps
- determination of chemical forms of heteroatoms such as nitrogen in large molecular weight or complex materials, for example to minimise generation of undesirable species such as NOx in coal combustion
- revealing the orientation of film crystallites to augment conventional XPS analysis of thin film materials for electronic and optoelectronic devices
- wet-cell, non-microscopic XAS investigation of solid electrode surfaces and particulate slurries.

Case study 1

Surface analysis techniques

Macquarie University's Prof Stephen Thurgate is developing a new generation of Auger photoelectron coincidence spectrometers to improve surface analysis techniques with applications in nanotechnology. As an expert in XPS, Thurgate has previously used synchrotron facilities to pioneer grazing incidence XPS, to measure very thin oxide layers on semi-conductors, in the range 20–100 Angstroms.

Case study 2

Mineral surface properties

Associate Professor Bill Skinner (The Wark Institute, Adelaide) and Professor Alan Buckley (UNSW, Sydney) and their colleagues are using standard laboratory based measurements in conjunction with high-resolution synchrotron XPS and NEXAFS to study the fundamental electronic and surface structures of a range of minerals. Knowledge of the surface properties of these minerals is key to understanding characteristics such as ion adsorption, oxidation and surfactant uptake—and the role these play in the initial stages of turning raw minerals into useful products.

Beamline specifications

Source	elliptically polarised undulator
Energy range	90 -2500 eV
Optimal energy range	90 – 2000 eV
Resolution deltaE/E	between 5000 and 10,000
Nominal beam size at sample (horizontal x vertical)	0.15 mm by 0.015 mm
Flux at 400 eV	Between $3x10^{12}$ and $5\ x10^{11}$ photons/s/200mA at the sample
Techniques available	• NEXAFS • photoemission

Contact info

Name **Bruce Cowie**
Phone **+61 3 8540 4160**
Email **bruce.cowie@synchrotron.org.au**
Web **www.synchrotron.org.au**

Australian Synchrotron
lighting the path to innovation