Australian Synchrotron

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The Soft X-ray Beamline at the Australian Synchrotron

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Introduction

A Soft X-ray beamline is being built at the Australian Synchrotron, the beamline will eventually have two branches operating in a time sharing mode. The first branchline is described here and will be dedicated to photoemission and NEXAFS. Initially the beamline will build on the expertise of the Soft X-ray community of Australia; particular strengths of this community lie in:

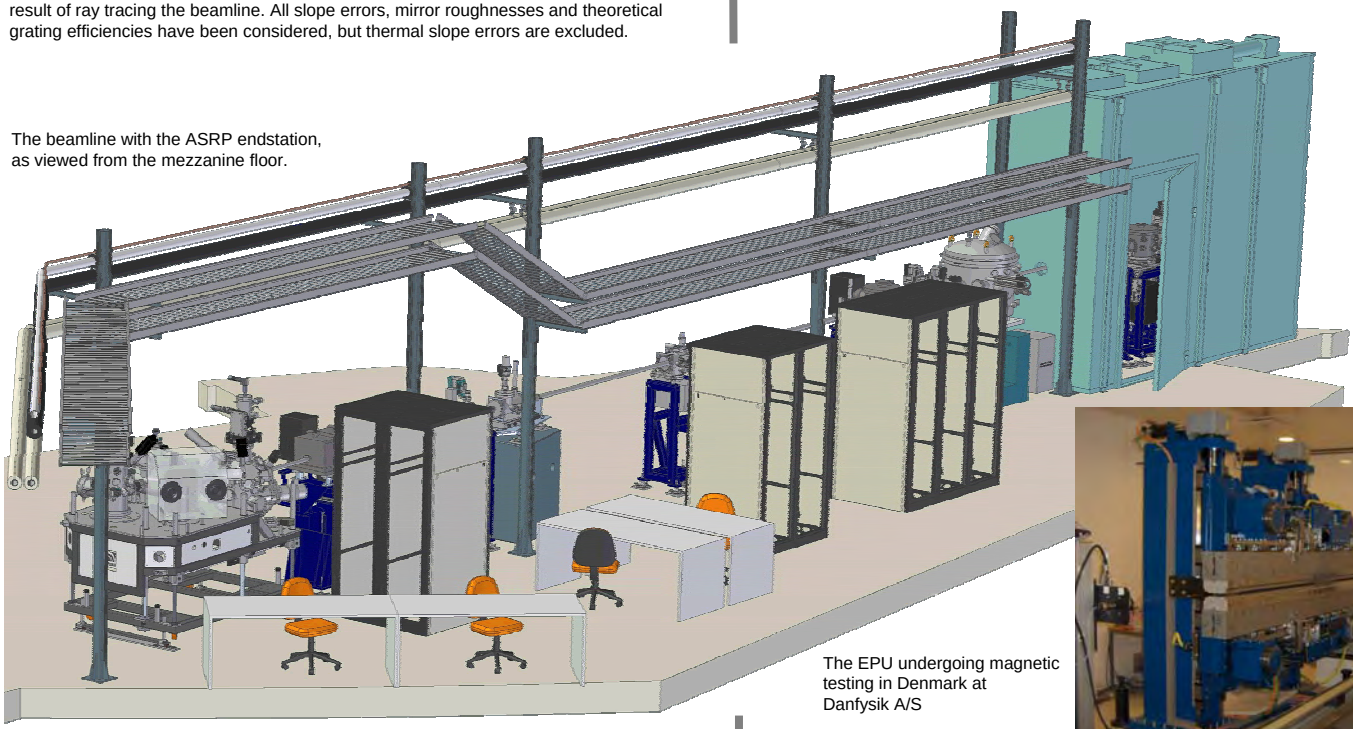
- Mineral Surface Chemistry and Reactivity –Surface Modification of polymers;
- fundamental studies in solid state physics; and
- nanotechnology as applied to chemical problems in catalysis and coal combustion.

The ability to produce highly circular polarized light will also be of significant benefit for researchers of magnetic systems.

The basic design of the beamline is a collimated light Plane Grating Monochromator (PGM). The beamline will be supplied complete by FMB GmbH based in Berlin. Planned first light operations will be in March 2007. One notable feature of the beamline design is the extended energy range to be covered. In particular, the S K edge at 2470 eV is an important goal for the users of the beamline. The performance of the beamline reported here is the result of ray tracing the beamline. All slope errors, mirror roughnesses and theoretical grating efficiencies have been considered, but thermal slope errors are excluded.

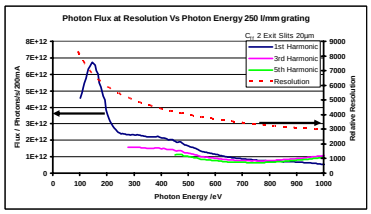
The Undulator

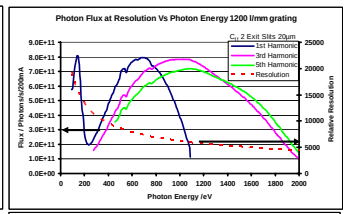
The undulator for the beamline will be an EPU (Elliptically Polarized Undulator) a variant of the APPLE II (Advanced Planar Polarized Light Emitter) from Danfysik A/S. In this device the normal magnet arrays of a planar undulator are split into two along the length of the undulator. By horizontally shearing the magnets arrays with respect to each other a sinusoidal horizontal magnetic field can be produced down the electron beam axis. The coupling of horizontal and vertical magnet fields can produce Soft X-rays with any degree of polarisation. An EPU differs from an APPLE II in that each horizontal magnetic array can move, whereas for an APPLE device only two opposite arrays are able to move; the other arrays being fixed. The fundamental harmonic of the beamline will be able to run between 90 and 1000 eV in horizontal linear polarisation. The resultant magnetic field for other polarization modes is reduced compared to that of linear horizontal polarisation. Full arbitrary polarization control can only achieved with photon energies greater than 190 eV. The vertical gap versus photon energies is shown for 4 different modes. Only in the case of linear and horizontal polarization is the phase shift of the horizontal arrays fixed with respect to each other at 0 and ½ a period (37.5mm). For these modes, the undulator peak energy is tuned simply by moving the vertical gap. For other polarizations, cooperate movements of both the vertical gap and horizontal phase are required.



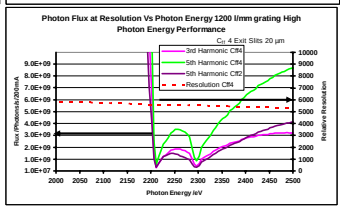
The beamline with the ASRP endstation, as viewed from the mezzanine floor.

The EPU undergoing magnetic testing in Denmark at Danfysik A/S

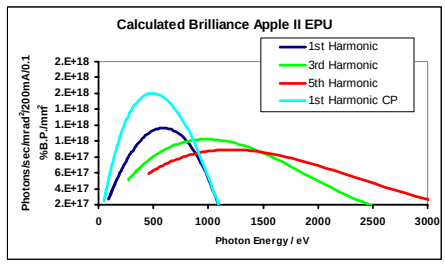




The 250 lines/mm laminar grating will operate between 90 and 1000eV (This is the range of the first harmonic of the undulator). The 1200 lines/mm grating will be a blazed grating giving the best efficiency at highest photon energies. A third grating with a line spacing of 500 lines/mm will be purchased.



The beamline will be installed on Straight section 14 of the ASP from January 2007. First commissioning light will be available from the start of March 2007.



EPU Parameters	
Magnet Period (mm)	75
Number of Full Periods	25
Minimum Magnet Gap (mm)	16
Nominal Device Length (m)	1.95
Number of Blocks per Period	4
Max Gap between Horizontal Arrays (mm)	1.6
Magnet Remanent Field (min) (T)	1.05
Magnet Block Material	Sm_2Co_{17}
Magnet Block Height (mm)	22.5
Magnet Block Width (mm)	35
Longitudinal Movement (mm)	+/- 40

The End Station

The user end station will be provided by the Australian Synchrotron Radiation Program (ASRP). This has been commissioned at the NSRRC in Taiwan. The end station will be arriving at the ASP after September 2007 and will become the principal user chamber. It has facilities for standard UHV surface preparation;
Ar Ion sputter cleaning, LEED, Heating and cooling (Liquid N2 routinely, Liquid He in the analysis chamber). In the analysis chamber there is a SPECS 150 hemispherical (9 channeltron) electron energy analyser and a partial yield/total fluorescence yield detector