

# **New 36-element Pixel Array Detector at the Australian Beamline**

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A new solid state detector system for fluorescence XAS experiments has been installed at the Australian National Beamline Facility at the Photon Factory in Tsukuba, Japan. The system consists of a 36-element monolithic planar germanium array (Canberra-Eurisys), digital signal processing electronics (XIA), a Zero Boiler liquid nitrogen recovery system (Canberra Japan KK) and integration and control software written mostly in SPEC (Certified Scientific Software). The complete system was purchased from and is supported by Canberra Japan KK.

The choice of technology and specifications of the detector system were matched specifically to the light source and instrumentation at the ANBF which sits on bending magnet port BL-20B at the Photon Factory. On a 2nd generation BM source with no focussing optics, many XAS experiments are flux-limited and data are collected at close approach to the sample. For this reason, a compact array with maximum active area:total area ratio reaps the maximum benefit from the available flux. The pixel array detector (PAD) technology was deemed the best fit to these criteria.

The germanium crystal used in the detector is 50mm square and has been surface modified and etched into a 6 x 6 array of pixels in which each pixel is 8mm<sup>2</sup>. These dimensions produce an array with an active area in excess of 2300 square mm. The solid angle subtended by the array at a given distance from the sample is very similar to that of the 10-element discrete crystal array formerly in use at the ANBF. The 10-element model had an active area of just 1000 square mm, giving a 2.3 fold increase in active area with the new PAD detector.

Overall detector throughput is also enhanced with this design as each pixel has a smaller surface area than each element of the superseded 10-element model. The larger active area and enhanced throughput, combined with the accurate deadtime correction capabilities of the digital electronics results in a total increase in fluorescence signal throughput of around a factor of 5.

## **Detector characteristics**

The maximum countrate is limited by the physical rise time of the photon signal in the detector. The 100% rise time was 450ns, giving a deadtime of about 1.5  $\mu$ s at 0.25  $\mu$ s shaping time and consequent maximum output countrate of about 250kHz per pixel (corresponding to a 675kHz incoming countrate). This gives a total output countrate of 9MHz for the full array.

Energy resolution (FWHM) averaged over all pixels measured at 5.9keV and 1000cps is 150 eV and 240eV at shaping times of 8  $\mu$ s and 1  $\mu$ s respectively.

## **System integration**

For a large array detector to be efficiently utilised in a busy user facility, maximum automation of detector channel configuration and operation is essential. The digital signal processing CAMAC-style XIA DXP4C2X modules provide such a capability. The modules were integrated with the detector in the factory and the system was tested and shipped as a complete unit.

The rich programming interface of the XIA modules has allowed development of SPEC macros which automatically determine and set optimum channel parameters with minimal knowledge or intervention required of beamline users. In addition, accurate automated deadtime correction is realised using the incoming countrate/outgoing countrate ratio and pixel livetime reported by the modules.

Performance characteristics and details of the system control and integration software will be presented.