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Large Solid Angle 50 mm^2 SDD for SEM Applications

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During the past decade, the silicon drift detector (SDD) has shown its performance advantages in many x-ray applications [1].

The characterization of nanoscale materials at high spatial resolution has become increasingly important to state-of-the-art research. A number of instruments ranging from Argonne National Laboratory's (ANL) sub-angstrom electron-optical instrument to the X-ray Nanoprobe are capable of extraordinary resolution to study these materials.

Concomitant with this high spatial resolution capability is the need to optimize ancilliary detector systems to maximize the information collected during any microanalytical investigation. While SDDs have shown their remarkable high count rate performance, there remains a second and equally important advantage to these detectors. The new generation of SDDs offers a range of alternate geometries, which are particularly useful in electron-optical beam-lines. A customized SDD can significantly increase the collection efficiency over that of traditional Si(Li) systems, and also over an SDD which is attached to the EM column in the common up-angle geometry. Typical solid angles for many beam-lines with traditional Si(Li) detectors, with areas 10 -100 mm^2, are in the range of 0.01-0.1 sR [2].

We have designed a custom 50 mm^2 SDD with a large solid angle (> 1 sR) that has been assembled into an SEM at the Electron Microscopy Center at ANL, for use in nanotechnology characterization. This system is ideally suited for the characterization of nanoparticles at ultra-high spatial resolution. The innovative design of the new SDD has made it possible to place the active area of the detector directly under the sample, to result in a configuration that significantly increases and maximizes the solid angle.

Figure 1 shows the common configuration of a traditional x-ray detector in a SEM, compared to the new large solid angle SDD design shown in figure 2. Figure 3 shows the measured increase in signal intensity as a result of the significant improvement in the solid angle of the new SDD configuration. These results and others will be reviewed in detail.

References

[1] S. Barkan, et al., *Microscopy Today,* 12 November (2004) 36.
[2] N. J. Zaluzec, *Microsc. Microanal.* 15 (2009) 93, 2009.

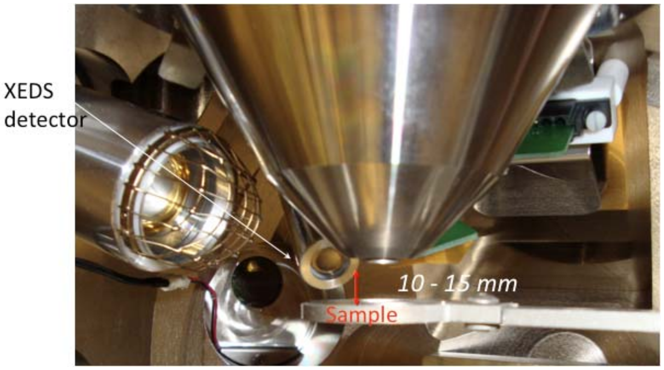

FIG.1. Common Si(Li) detector configuration inside the SEM column. Solid angle is 0.005-0.1 sR.

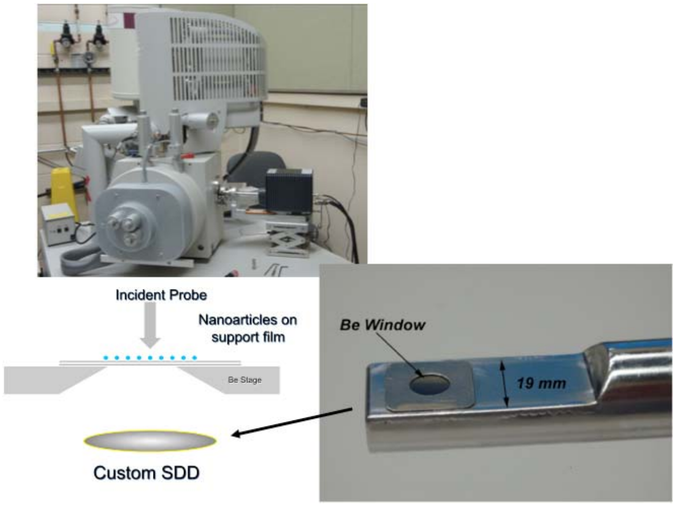

FIG. 2. The new SDD placed under the sample, results in a solid angle of more than π sR.

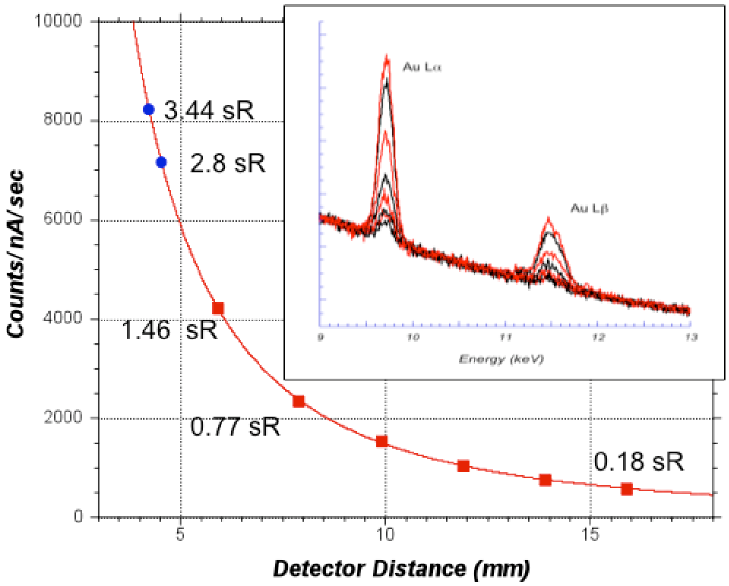

FIG. 3. Measured intensity (counts/nA/sec) as a function of distance from new SDD detector to sample. Numerical values at each data point are the calculated solid angle achieved.

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