Advances in X-ray Energy Dispersive Spectroscopy in the Modern Analytical Electron Microscope.

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The use (and abuse) of computationally mediated imaging and diffraction experiments at the nano-to-pico scale continues to increase in modern electron optical instruments. This is particularly relevant in the latest generation of aberration corrected electron optical instruments where advanced configurations are pushing the limits of what we in the past only dreamed of routinely accomplishing. However, at the same time, only incremental advances have been done to augment/improve our analytical capabilities. Spectroscopically, the most common signals are derived from inelastic scattering creating either electrons (EELS), photons (CL) or x-rays (XEDS). Each of these three have their own merits and they all complement each other occasionally having overlapping in functionality. Regardless of which of these three measurements are chosen, the sensitivity of each is directly tied to the ability to detect a characteristic *signal* above some continuum background from which a quantitative measurement can be realized. Since 2004, Argonne has been working on designs and implementations of linear arrays of Silicon Drift Detectors (SDD's) for x-ray energy dispersive spectroscopy (XEDS) in the Analytical Electron Microscope (AEM). The goal to maximize the solid angle, sensitivity as well as mitigate artifacts. Evolving our original π steradian detector solution [1] and collaborating with ThermoFisher Scientific [2], we have developed the X-ray Perimeter Array Detector (XPAD) which when combined with a custom electron optical pole piece (ZTwin) has improved the detector performance to a record collection angle of 4.5 sR. This magnitude of this improvement is illustrated in Figure 1 which plots the evolution of the experimentally measured solid angle of detectors on Analytical TEM/STEM instruments over the last 40 years.

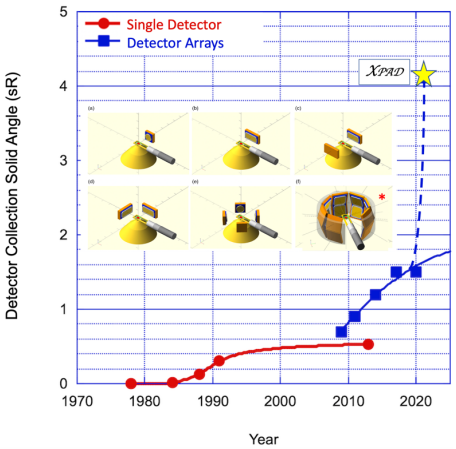

Figure 1: Evolution of the x-ray detector geometries and solid angle in the Analytical TEM.

References

[1] Argonne National Laboratory. (2010). US Patent 8,314,386

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