

Performance of a 30 mm² Silicon Drift Detector
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Silicon drift detectors (SDD) are x-ray detectors that operate at near room temperature. In the past, their spectral resolution at low count rates has not been as good as the best Si(Li) x-ray detectors, but these early detectors were not designed as Si(Li) replacements; they were designed for high count rate applications. As such, they perform extremely well, maintaining good spectral resolution at high count rates much better than traditional Si(Li) detectors. The first generation of commercially available SDD's performed spectacularly, but was limited in size to 5 or 10 mm². Larger active areas either required multiple SDD devices or a mechanical size that precluded its common use on electron microscopes. The size of the latest generation of detectors has an increased active area of 30 mm² in a package that can be used on most electron microscopes.

The SDD uses a different mechanism than Si(Li) detectors to measure the electronic pulse as the x-ray is absorbed by the detection crystal. As such, it has higher throughput for a given resolution than a Si(Li). The SDD was designed to provide good spectral resolution at high count rates. Although Si(Li) detectors can store 70 kps x-rays, the spectral resolution will degrade from the low count rate 129 eV resolution to greater than 200 eV. In contrast, SDD technology can store x-rays at rates exceeding 200 kps, but the spectral resolution degrades from 140 eV at low storage rates to only 175 eV at high storage rates. In addition, the low energy detection ability of SDD technology compared to Si(Li) detectors is much better at these high detection rates. The ability of the SDD's to maintain the lower spectral resolution at these high storage rates permits the acquisition

of spectral imaging data sets in much shorter collection times or for better statistics at the same collection times.

The latest development in SDD technology is the fabrication of a SDD device with an active area of 30 mm². This new generation of SDD has nearly 3 times the collection efficiency of a 10 mm² SDD at the same input beam current and sample geometry. The higher efficiency of this new generation of SDD's permits the rapid acquisition of spectral imaging data sets in SEM's without the need to irradiate the sample with high, potentially sample-damaging beam currents. These detectors now permit routine spectral imaging acquisitions on a wider range of microscopes than would have been possible previously.

An additional benefit of the new fabrication technology is the ability of the SDD to provide comparable spectral resolution as the original 10 mm² SDD at high count rates. In the case of Si(Li) technology, an increase of the crystal size from 10 mm² to 30 mm² reduces the spectral resolution by a small but measurable amount. The detector fabrication and detection electronics cannot overcome limitations in the physics of larger crystals. In the case of the larger SDD, new design and fabrication techniques of the crystals has provided comparable spectral performance with no adverse effects. The primary benefit to the microanalyst is the higher storage rate of the larger crystals with the spectral performance of the smaller crystals.