

# Single- and Four-Element Large Area Silicon Drift Detector X-Ray Spectrometers for XRF Applications

**V. D. Saveliev, L. Feng, C. R. Tull, S. Barkan, M. Takahashi, E. Damron**

SII NanoTechnology USA Inc., 19865 Nordhoff St., Northridge, CA 91324, USA

*E-mail: vsaveliev@siintusa.com*

A silicon drift detector (SDD) offers excellent energy resolution together with a large active area and a high count rate capability. These features are typically required by modern x-ray spectroscopy using synchrotron beams, such as EXAFS (Extended X-Ray Absorption Fine Structure) and XANES (X-Ray Absorption Near-Edge Structure) that are powerful means for material studies in a wide range of fields including chemistry, biology, surface and material sciences, geology, environmental science, as well as the state-of-the-art nano-materials research.

We have developed the Vortex<sup>®</sup> SDD that has a large active area of  $\sim 45 \text{ mm}^2$ , fabricated on  $\sim 0.35 \text{ mm}$  thick, high resistivity n-type silicon. These SDDs operate with thermoelectric cooling and feature excellent energy resolution ( $< 130 \text{ eV}$  FWHM at 5.9 keV and optimum peaking time) [1]. They also exhibit a very short signal rise time ( $< 100 \text{ ns}$ ) allowing pulse processing using very short peaking times ( $\sim 0.25 \mu\text{s}$ ) to achieve very high signal throughput (300 – 500 kcps output rate). Based on these SDDs we have developed variety of single- and four-element x-ray spectrometers (the Vortex-EX<sup>®</sup>, Vortex-EM<sup>®</sup> and Vortex-ME4<sup>™</sup>), that are successfully used in synchrotron applications and demonstrate high performance [2].

The Vortex<sup>®</sup> spectrometers design utilizes SDDs installed directly on a thermoelectric coolers with the heat removed through an innovative heat pipe heat transfer system. This design enables us to develop customized x-ray spectrometers with a detector snout length up to 800 mm, including ultra high vacuum compatible versions. The main design features as well as the performance data, including performance in a high magnetic field, of the Vortex<sup>®</sup> single-element and four-element spectrometers will be presented.

## References

- [1] V.D Saveliev, C.R. Tull, L. Feng, S. Barkan, M.Takahashi, E.V. Damron, “Advanced Large Active Area SDD for X-Ray Spectroscopy”, *Microscopy and Microanalysis*, vol. 14 (2008), Suppl. S2 , pp. 1140-1141
- [2] J.C. Woicik, B. Ravel, D.A. Fischer, and W.J. Newburgh, “Performance of a four-element Si drift detector for X-ray absorption fine-structure spectroscopy: resolution, maximum count rate, and dead-time correction with incorporation into the *ATHENA* data analysis software”, *J. Synchrotron Rad.* vol.17, Part 3 (May 2010)