CHARACTERIZATION OF SILICON DRIFT DETECTORS FOR EDXRF

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The application of thermoelectric cooling to Si diodes optimized for energy dispersive X-ray spectroscopy (EDXRF) has led to the development and widespread use of portable X-ray fluorescence analyzers, but these systems are limited by the energy resolution and maximum count rates of conventional diodes. Silicon drift detectors (SDDs) offer better energy resolution and much higher count rates than conventional diodes, however, their expense has restricted their use to high end products.

Amptek, Inc. developed custom thermoelectrically cooled SDDs for EDXRF which provide the high performance of SDDs yet are affordable for widespread usage. Two generations of SDDs have been developed: a 7 mm^2 detector, with a resolution of 136 eV FWHM at the 5.9 keV Mn K_a line, and a 25 mm^2 detector, with a resolution of 128 eV FWHM. Both use a two-stage Peltier cooler reaching 210K. This paper will characterize the performance of Amptek's SDDs and compare it to that of conventional Si diodes. The paper will show the electronic noise and energy resolution under laboratory and field conditions; the resolution, dead time, and stability over count rate and temperature, and the sensitivity and spectral response for a range of X-ray energies. Precision and accuracy will also be shown for representative applications.