Extremely High Count-Rate Performance of Silicon Drift Detector
S. Barkan, L. Feng, V.D. Saveliev, M. Takahashi, M. Uehara, Y. Wang, E.V. Damron
Hitachi High-Technologies Science America, Inc. Northridge, CA 91324

The high count-rate advantages of silicon drift detectors (SDD) has previously been presented for several x-ray applications. Recently, further significant improvement in the high count-rate capability using a 50 mm$^2$ Vortex SDD has been successfully achieved using the CUBE preamplifier from XGlab, Milano, Italy, combined with the “Mercury” Digital Pulse Processor (DPP) from XIA, Hayward, CA. The ability to combine the advanced technologies of silicon drift diodes and adaptive digital pulse processing, allows a dramatic increase in the data volume which can be collected and enhance the efficiency of the measuring methods whenever high count rate and good energy resolution is playing an important role.

A 50 mm$^2$ SDD was evaluated at the Hitachi High-Technologies Science America’s lab, in a series of experiments to analyze its high count-rate capability specifically for XRF applications. An output count rate of 0.87 Mcps at 2.3 Mcps input count rate (60% DT) was achieved and the results showed stable performances under different operational conditions. The improvement in high count-rate capability was achieved by decreasing the rise time to 30 ns and by combining the SDD with the new improved “CUBE” preamplifier from XGlab and using the “Mercury” data acquisition system, designed at the XIA.

For the evaluation of the SDD, Mn spectra were taken over a range of count rates. The energy resolution at 2.3 Mcps found to be 180eV, while keeping resolution close to the theoretical limit at low count rate (~124eV). These very high count rates open up new areas of materials evaluation that were not previously possible with the slower x-ray spectrometers. Examples of preliminary XRF results obtained with the Vortex SDD, the “CUBE” and the “Mercury” Digital Pulse Processor is presented in the figure 1 below.

Fig. 1. Throughput of 50 mm$^2$ Vortex SDD with “CUBE” preamplifier and “Mercury” DPP. Conditions: Mn sample excited by an Oxford Rh tube operated at 40 kV
50 mm² Vortex SDD, “CUBE” preamplifier and “Mercury” DPP.