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Reasons to Replace a Proportional Counter (PC) in the Wavelength Dispersive Spectrometer (WDS) with a Silicon Drift Detector (SDD)

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Electron probe microanalysis (EPMA) has been around for well over 50 years and is still widely used today for elemental composition of a material and determining the distribution of elements and their concentrations within a sample surface via point analysis and/or X-ray mapping (XRM). The EPMA of today allows for energy dispersive (EDS) and wavelength dispersive spectroscopy (WDS) analysis by collecting characteristic X-rays and continuum released from the sample surface after bombardment with electrons.

Wavelength Dispersive Spectroscopy (WDS) systems are very valuable microanalysis systems that exhibit far better spectral resolution than the conventional energy dispersive spectroscopy (EDS) systems [1-3, 7]. The combination of EDS and WDS produces a very powerful analytical technique allowing for excellent Quantitative X-ray Mapping (QXRM) [4-5, 7].

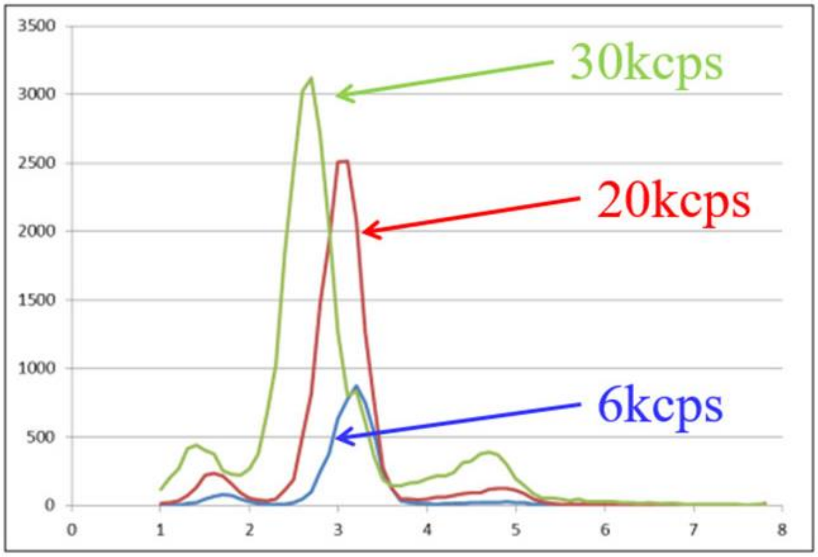
Traditional wavelength dispersive spectrometers (WDS’s) design utilises a gas counter (GC) or proportional counter (PC) [1-3]. The traditional GC-WDS has many issues including things like the gaseous detector resolution and stability [1-3]. The electron microprobe operator using WDS has to be meticulous in monitoring items such as gas flow, gas purity, gas pressure, noise levels of baseline and window, gas flow proportional counter (GFPC) voltage levels, count rate suppression, anode wire contamination and other detector parameters [1].

The superiority of a WDS(SD) is easily seen once in operation [3-6]. The incorporation of the SDD has been found to provide the following:

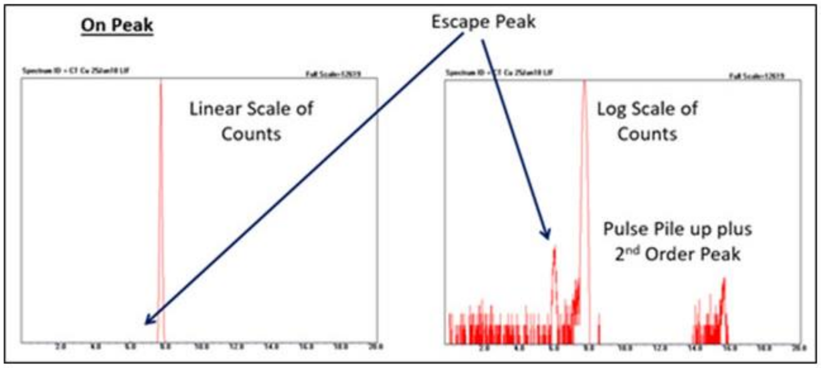
1. No more peak shift with count rate (Figure1a).
2. No more high order diffraction included in collection (Figure 1b).
3. No more interferences from extraneous X-Rays (Figure 1b & c).
4. No more peak shift (drift) with air pressure.
5. No more slowly deteriorating proportional counter due to gas contamination.
6. No more gas, better vacuum.
7. Better peak to background ratio’s (P/B) (Figure 2).
8. Better energy resolution.
9. Better low energy performance (improve the light and mid element range)
10. Ability to do analysis without measuring backgrounds.

Any one of these is reason to go to a solid state detector, WDS(SD), (SDD in WDS). But, all ten points would be silly and even irresponsible not to upgrade. The first 9 points have to be done correctly, before considering point 10. This presentation will cover advantages and current limitations of WDS(SD) as well as our current research on background determination.

This presentation will cover the above ten points but also go through future requirements necessary for making this incorporation even more powerful and valuable [8].



a.



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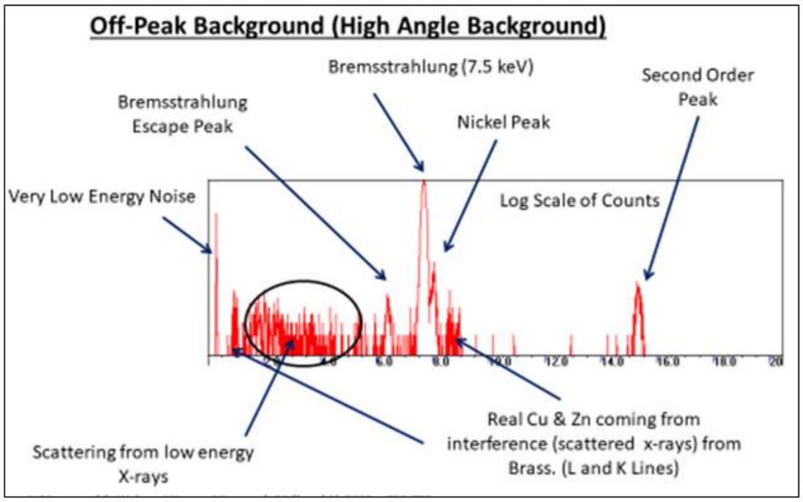
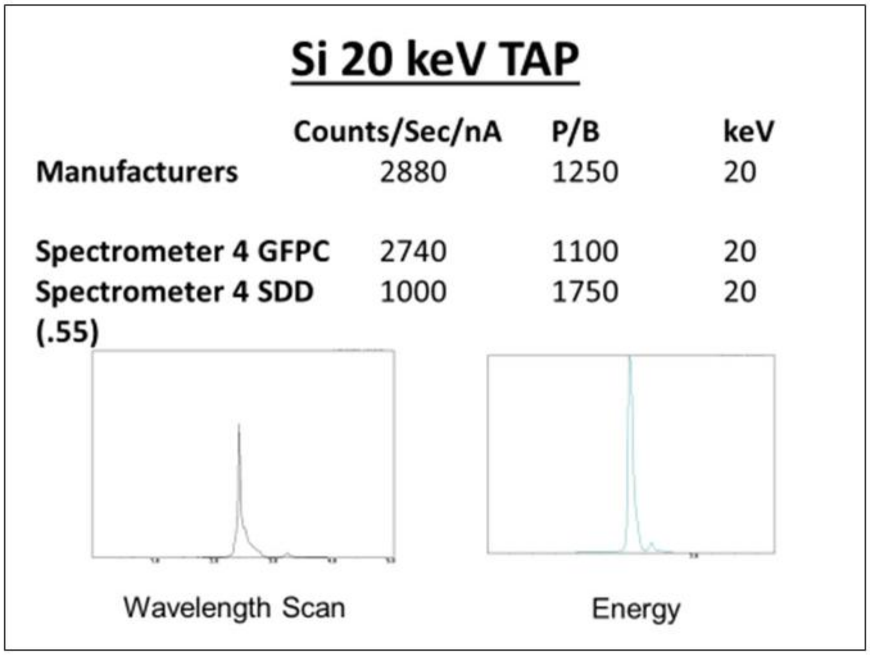


c.

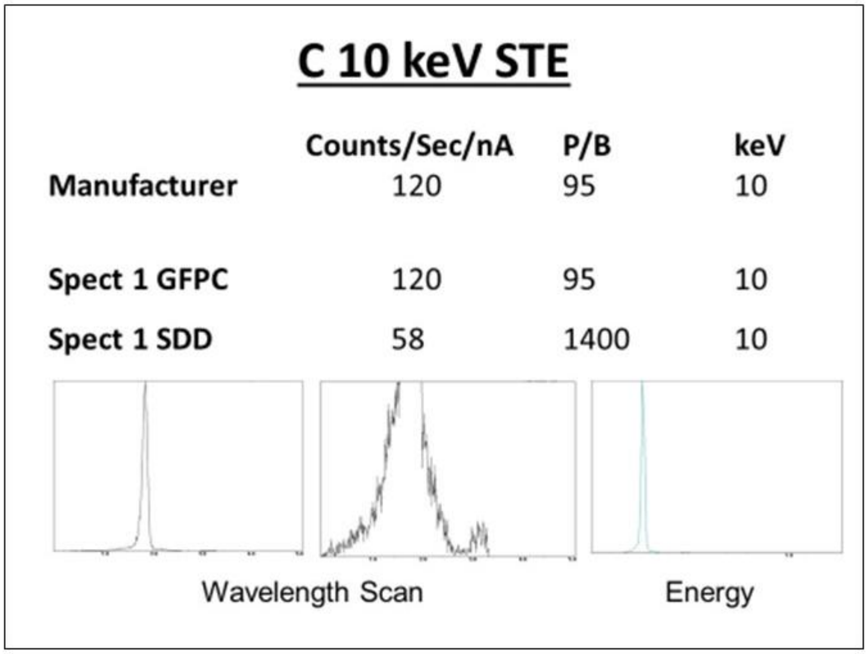
Figure 1. a) Proportional counter (PC) pulse height distributions (PHD) at different count rates, b) SD-WDS peak position of a Cu Spectrum, counts (Y) versus energy (X) for Copper spectrum measured on WDS(SD) at the peak position. First order bremsstrahlung is under the peak. Second order bremsstrahlung is shown coinciding with pulse pile up while everything else is an artifact of the system and c) .WDS(SD) off-peak background (High Angle Background), counts (Y) versus energy (X) for off copper peak spectrum measured on WDS at the off-peak position.



Si 20 keV TAP

	Counts/Sec/nA	P/B	keV
Manufacturers	2880	1250	20
Spectrometer 4 GFPC	2740	1100	20
Spectrometer 4 SDD (.55)	1000	1750	20

a.



C 10 keV STE

	Counts/Sec/nA	P/B	keV
Manufacturer	120	95	10
Spect 1 GFPC	120	95	10
Spect 1 SDD	58	1400	10

b.

Figure 2. Spectrometer performance data for a) TAP and b) STE crystals. Figures a) and b) compares the manufacturer's best performance, with the previous proportional detector performance, and the new SDD performance (SD-WDS). In all cases the counts for the SDD are lower because the detector active collection area is 6 mm2 compared to 20 mm2 for the PC. For the SDD the peak to background (P/B) ratios are much better for all the crystals.

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