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Real Time Color Scans with Scanning Electron Microscopes – A New Application of the XFlash® X-ray Detector Technology

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In recent years, x-ray detector technologies based on silicon drift diodes (SDD) have been employed for microanalysis (EDX) on scanning electron microscopes in increasing numbers. Compared to conventional Si(Li) or HP Ge crystal detectors, these new detectors are superior in terms of performance, reliability and speed. Furthermore, an integrated thermoelectric cooling element eliminates the need for liquid nitrogen or other consumables for operation, resulting in a very compact, lightweight detector [1].

The second generation of RÖNTEC XFlash® detectors marks a breakthrough in the development of SDD detector technologies. Its energy resolution of 127 eV now exceeds that of the widely used Si(Li) detector. Moreover, the low energy detection capability has been extended to include light elements. With its high X-ray pulse throughput capabilities, XFlash® opens the door for enhanced EDX applications and at the same time is very well suited for other analysis methods (e.g., XRF, PIXE).

One of the most outstanding XFlash® applications in the field of electron microscopy is the RÖNTEC ColorSEM system which was specifically designed to provide a new imaging capability at the SEM. Within seconds it generates precise composite color images based on the characteristic X-rays of the specimen. These brilliant, high resolution images are built from up to 8 high-speed, single-color X-ray maps with each color representing an individual element. The acquisition time of a composite image (up to 2048 x 1536 pixels) is similar to that required for a high quality SE/BSE image on the SEM. In contrast, conventional EDX maps at 256 x 256 pixels can often take up to a half hour to acquire[2].

The rapid acquisition is due to the high processing capabilities of the RÖNTEC XFlash® detector and its electronics unit. Capable of handling up to 400,000 cps, the system is 13 times faster than conventional mapping systems. Individual X-ray “raw data” maps (each with 16 bit pixel resolution) are blended with the SE/BSE image electronically in order to produce the spatial impressions. ColorSEM is a stand-alone imaging system that can be easily fitted to SEMs of any type and model.

ColorSEM images are exceptional in speed, contrast and resolution and have become a powerful tool for the microanalyst examining compositional features as small as one micrometer. The display of element gradients provides detailed information on grain boundaries, phase details or micro inclusions as well as the identification of particles and fibers.

The ability to produce “color scans” at the scanning electron microscope has great potential to revolutionize electron microscopy. The fast and easy visualization of element distributions in a specimen and the identification of microstructural features and compositional variations of different materials can be more easily interpreted, particularly by persons unfamiliar with electron microscopy. In addition to secondary and backscattered electron images “color scans” introduce rapid color with maximum resolution to the SEM.

References:
[1.] J. Gannon et al., A new methodology for element imaging in the scanning electron microscope, Microsc. Microanal. 7 (Suppl 2: Proceedings) 884
[2.] M. Procop: Fast Elemental Mapping in Materials, Microscopy and Analysis 1 (2002) 17

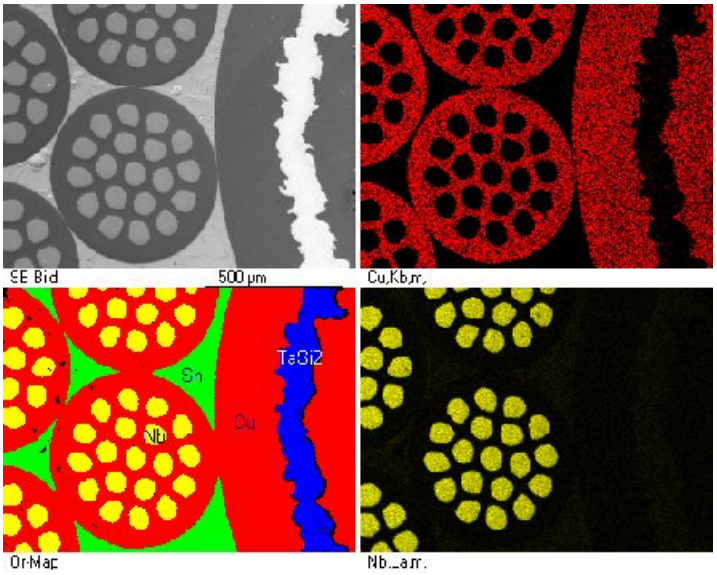
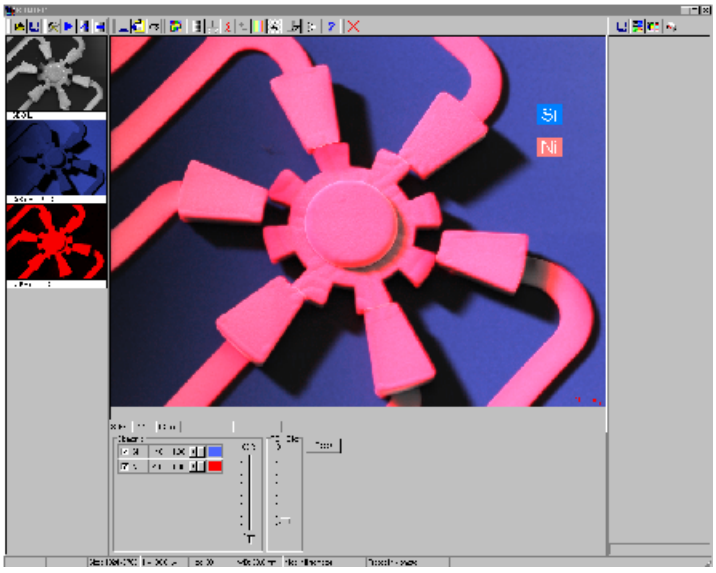


Figure1 (above). Superconductor (R&D Application). Cross-section of a superconducting cable. The superconducting filaments (wires) are embedded in a Cu matrix. This 256x192 pixel image was acquired in 20 seconds (one scanning cycle). Courtesy of Dr. M. Procop and K. Meyer (BAM).

All colors (here presented in grayscale) become more apparent in the original color image.

Figure 2 (below). Composite element image of a MEMS micromotor. Left: two “raw data” maps (Si, Ni) with 16 bit data depth each. Center: Automatically generated color scan image.



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