Overcoming energy-dispersive X-ray spectrometry (EDS) detection limits with XTrace, a focused X-ray photon source on SEM

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Energy-dispersive X-ray spectrometry (EDS), a common analytical scanning electron microscope (SEM) technique, reaches a detection limit of 0.1 wt. %, which is sufficient for the majority of applications. However, often elements in lower concentrations are influencing the properties of the material. The detection and quantification of these elements is an important application, which cannot be performed with EDS on SEM. Often this analytical challenge is solved by standalone Micro-X-ray fluorescence spectrometer (Micro-XRF). Mounting XTrace, a focused X-ray photon source, on an SEM allows solving this analytical task by bringing the capability of a complete Micro-X-ray fluorescence spectrometer to an SEM. XTrace consist of a modern X-ray polycapillary optic to focus X-rays to a spot size of less than 30 µm.

The combination of SEM and XTrace results in a dual potential beam system, an electron beam generated by SEM and an X-ray beam generated by XTrace. No sample change or position change of the sample is necessary, if an analysis with both EDS and XRF is desired. This combination extends the analytical potential of the SEM to trace element detection down to ppm (parts per million) level. Depending on matrix and element, a mass concentration down to 10 ppm is detectable. The high sensitivity of Micro-XRF is based on a lower spectral background and a higher peak to background ratio compared to electron excitation for elements with an atomic number > 20. In addition Micro-XRF enables the full energy range up to 40 keV due to excitation close above the absorption edge.

The sensitivity and improvement for trace element detection will be demonstrated on different sample types like steels, alloys, glass, geological samples and polymers.

EDS and Micro-XRF spectra comparison