



# EDS Analysis

Technical White Paper

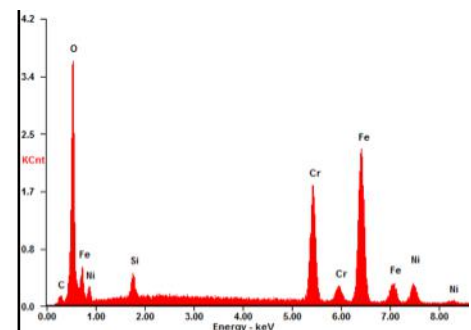
## EDS Analysis

SureScreen Scientifics use the Energy Dispersive X-ray Spectroscopy (EDS or EDX) function of the Scanning Electron Microscope (SEM) for a wide range of analytical applications within engineering on conductive or semi-conductive samples. The EDS works in conjunction with the microscope to attain a superior understating of the materials being examined. The function of the EDS is to provide a semi-quantitative chemical breakdown of the elements present in the microscope field of view.



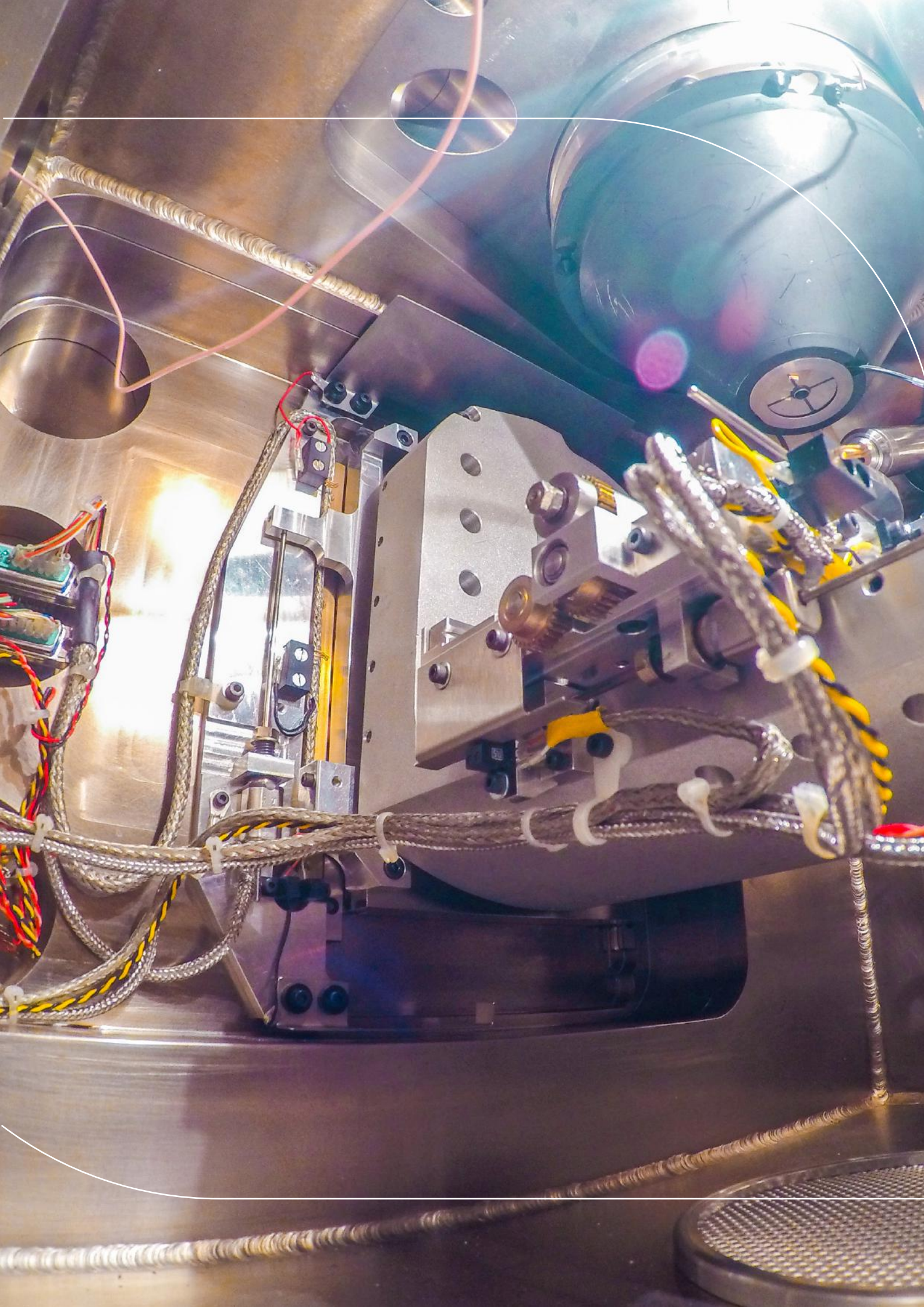
*SureScreen's SEM instrument with the 'EDAX' EDS analyser attachment (enlarged on the next page).*

X-Rays are emitted from a sample during bombardment of high-energy electrons within the SEM. Each atom within the sample produces characteristic X-ray radiation of a unique energy which is derived from the electron orbitals. The EDS detector measures the intensity of the X-rays emitted, which have a direct correlation with the concentrations of the elements within the sample. The EDS analyser is capable of detecting elements with an atomic number of 5 and above, which is suitable for most applications as an indicative analysis. The EDS produces a spectra which is interrogated by the analyst and elements are assigned to the spectral peaks. The quantification is then provided in either atomic weight (at%) or percentage weight (wt%).



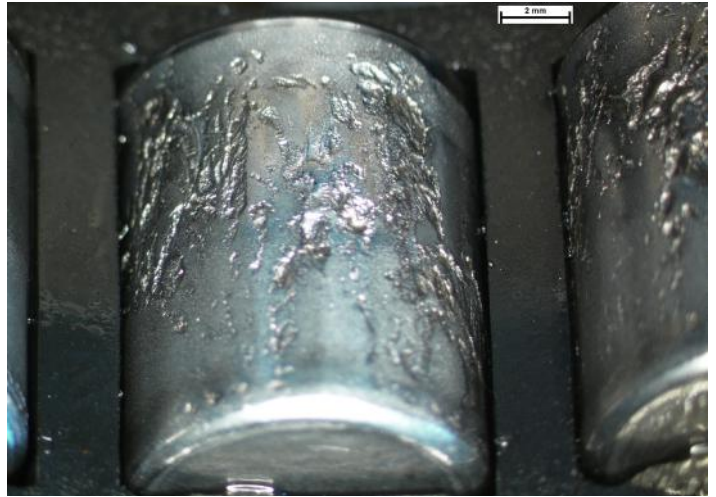
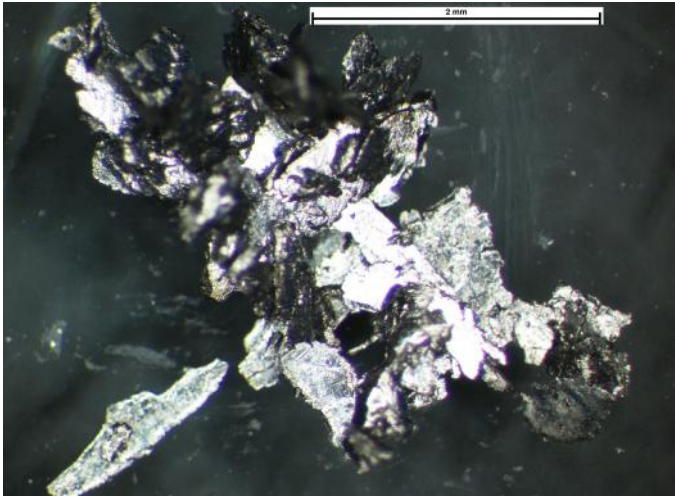
*Typical spectrum gathered by the EDS analyser*







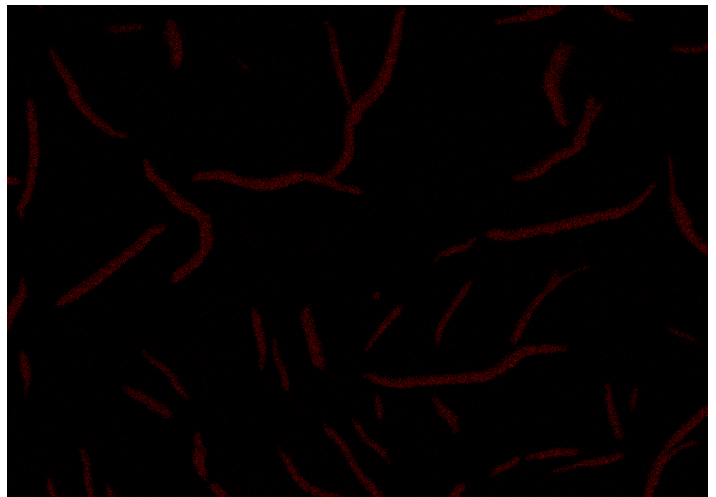
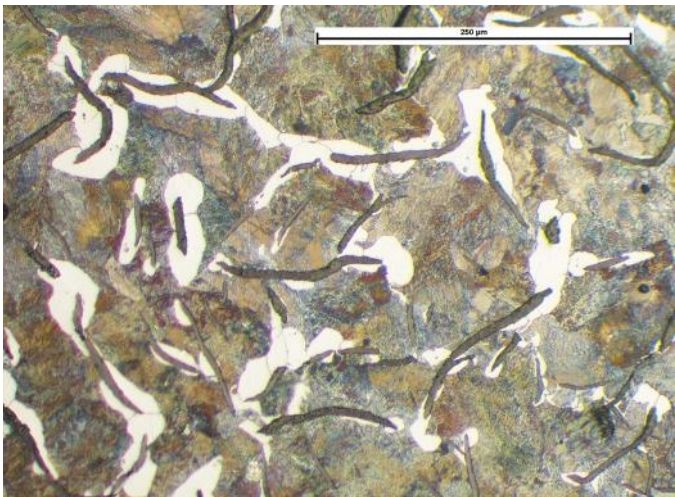
The EDS has a range of analytical functions suitable for differing applications. The most broadly used is the bulk analysis whereby a portion of the gathered image is selected for analysis. This is used for applications such as contaminants, oxides, coatings and material identification.



*Analysis of wear debris from a filter (left) can help establish the origin of a degrading component (right) especially when combined with visual and SEM examination of the size and form of the debris. Above images are from an optical microscope.*

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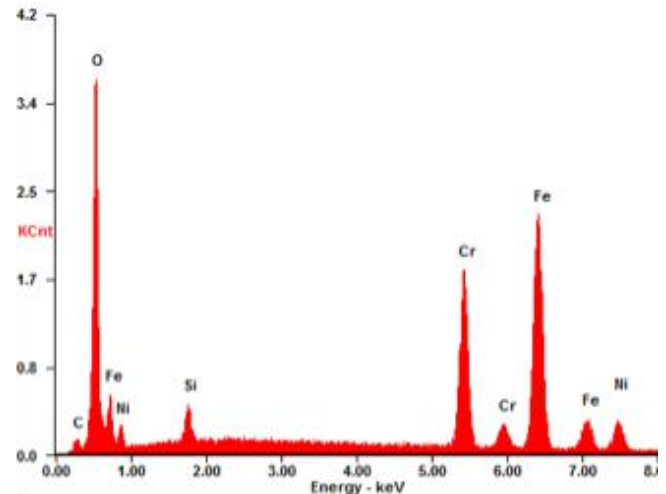
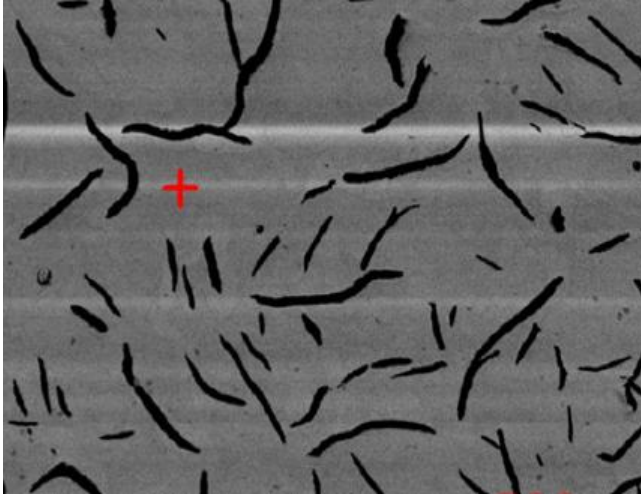
Element mapping is performed by rastering the beam over a selected area of the sample for a prolonged period of time. This builds up a 2D map of the selected elements which are displayed as various colours.



*Comparative images of the microstructure of grey cast iron at X200 magnification. Optical image (left) and element mapping of carbon (right) illustrating how the mapping reveals the distribution of specific elements.*

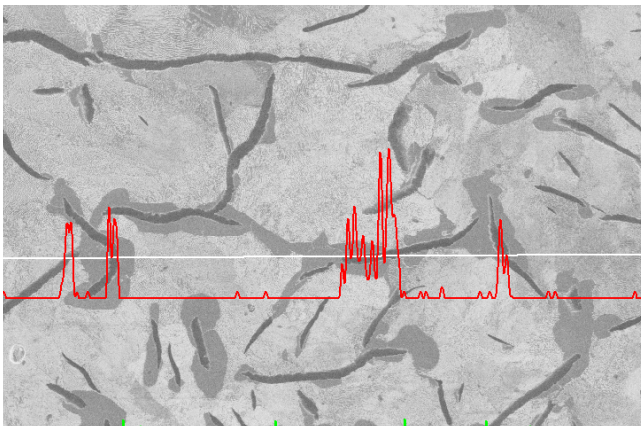
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Spot analysis is used for analysing specific points on a gathered image, such as phases in metallurgical samples.

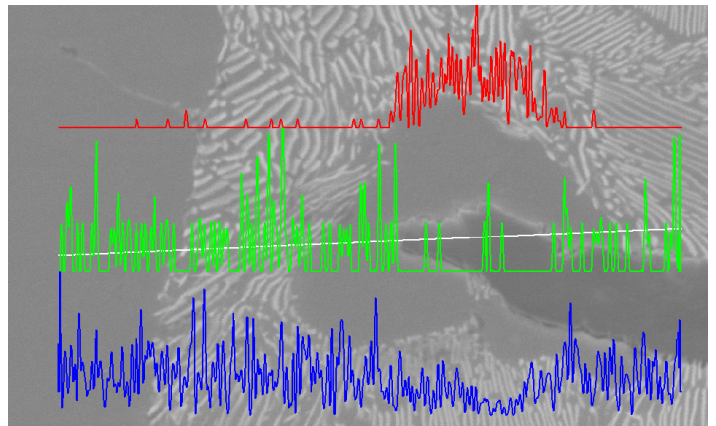


A light area observed using the back scattered electron image. Spot analysis of the area revealed it to be a manganese sulphide inclusion which is typical in iron alloys.

Line scan is a function used to identify variations in element concentration along a line.



Line scan used to display peaks in carbon concentration when the line passes a graphite flake in the grey cast iron microstructure.



Line scan through the graphite flake at X3000 magnification.

The EDS function of the SEM has a great degree of versatility and is used in nearly all of the comprehensive failure investigations conducted at SureScreen. The EDS can be used at magnifications up to X10,000 to establish grain boundary effects in metallurgical samples and also at X50 for bulk analysis of materials.

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