X-ray Analysis in the SEM

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X-ray analysis in a scanning electron microscope (SEM) provides quantitative information about the elemental composition of the sample. The x-rays are produced when the electrons hit the sample surface. As a consequence the technique can be used to image the spatial variations in composition within the sample. Each of the SEMs in CFAM is equipped with X-ray analysis systems. The details of each system vary from instrument to instrument but each is an Oxford Instruments INCA system. Each SEM is equipped with an energy dispersive detector. The environmental SEM also has a wavelength dispersive system which runs in parallel with the energy dispersive detector. The type difference is the resolution, the wavelength system is considerably higher (peak widths as low as 2eV) than the energy dispersive detector (~150eV).

How does it work?

If the innermost shell (the K shell) electron of an iron atom is replaced by an L shell electron, a 6.4 keV K alpha X-ray is emitted from the sample. Whereas if the electron is replaced by an M shell electron or an N shell electron, a 7.057 keV K beta or a 0.704 keV L alpha X-ray is emitted. Since lower atomic number elements have fewer filled shells, they have fewer X-ray peaks. Carbon for example, has only one peak, a K alpha X-ray at 0.282 keV.

Essentially, each element has characteristic X-ray line(s) that allow a sample's elemental composition to be identified by a non-destructive technique.

How does it work continued?

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Schematics from www.seallabs.com