Phenom™ imaging by backscattered electron detection

Backscattered Electron detection is the basis of Phenom™ imaging. This type of signal provides images with compositional and topographical information.

Every sample emits several types of electrons (signals) when hit by a primary electron beam. One type of these emitted electrons is the backscattered electron (BSE).
The most commonly used detector is the solid state type (semiconductor device).
The solid state backscattered detector in the Phenom™ is mounted between the sample and the objective lens (see Figure 1). The electron beam passes through the middle of the detector and amplifies the signal produced by the impinging electrons. The result is a gray scale image based on the contrast produced by the sample. Because the Phenom image is electronically produced, it can be subject to all kinds of post image analysis.

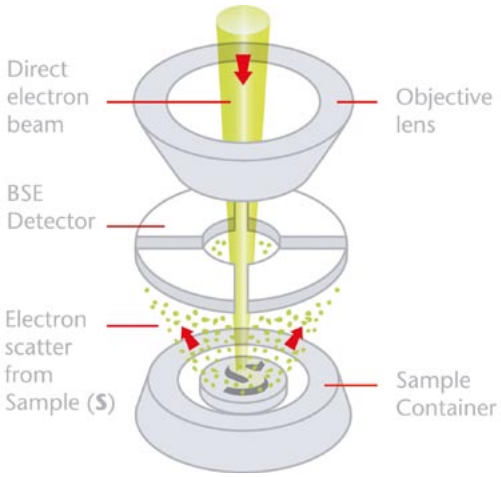

Figure 1. Schematic representation of the Phenom detection system.

BSE's vary in their amount and direction due to the composition and topography of the specimen. The contrast of the backscattered electron image depends on factors - like the atomic number (Z) of the sample material, the acceleration voltage of the primary beam, and the specimen angle (tilt) with relation to the primary beam. Backscattered electrons therefore give useful information about the composition and surface topography of the sample.
Backscattered electrons are generated inside the material; therefore BSE's provide material contrast information. Material with a high atomic number (Z), like gold (Au) will generate more BSE's than material with a lower atomic number, like silicon (Si). Because of these differences in backscatter yield the detector can be used to identify different phases and/or inclusions. See Figure 2.

Using an electron beam instead of visible light (like in a light microscope) has many advantages in respect image quality. The maximum magnification that can be reached with a Phenom is 24,000x. Light microscopy is limited to 1,000x. An electron beam will produce a much larger depth of focus and sharper image compared to a light microscope. Figure 3 will show an image of diatoms taken with a light microscope at a magnification of 1,000x. Figure 4 will show an image of diatoms taken with the Phenom at a magnification of 3,000x. Clearly visible is the better depth of focus and overall sharpness.

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Figure 2. BSE image taken by Phenom showing large compositional contrast (Gold wire on Si-wafer)

Figure 4. Image of diatoms taken by Phenom (magnification 3000x)

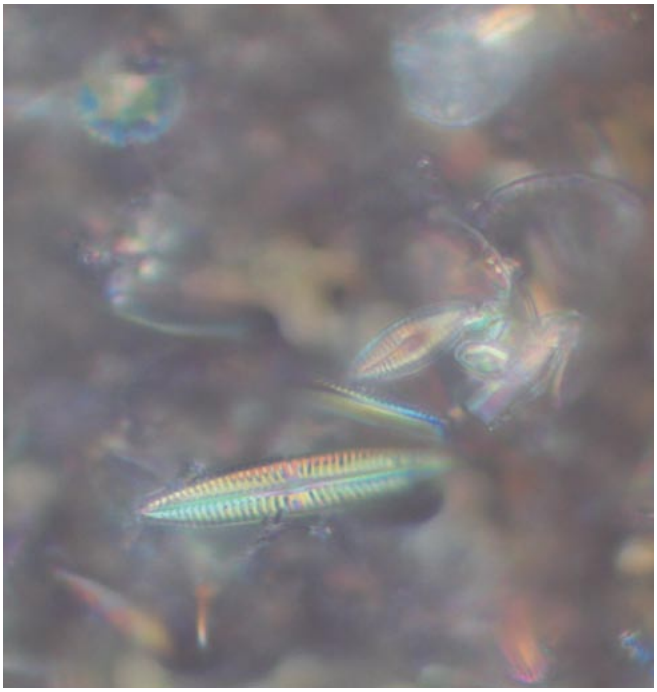

Figure 3. Image of diatoms taken by light microscope (magnification 1000x).

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