FEI Verios 460L

The FEI Verios 460L field-emission scanning electron microscope (FESEM) is an ultra-high resolution Schottkey emitter SEM. The Verios 460L is an unconventional SEM. Through clever design, the Verios 460L allows for ultra-high resolution imaging at low energy on insulating samples with no conductive coating.

The Verios 460L has an upper corrector (aka monochromator) that reduces the energy spread in the beam by an order of magnitude. This significantly reduces chromatic aberrations. The Verios 460L has an integrated sample bias system that allows for high energy in the electron optical column and low electron energy at the sample. This allows the best of both worlds since high energy electrons are easier to control precisely and low energy electrons show more surface detail, create less beam damage, and reduce charging effects. The Verios 460L uses a projection condenser lens, i.e., the current is controlled by changing apertures instead of changing the lens strength. This means that the system is very stable since the lens temperature is constant. The Verios 460L has an objective lens that can be operated as a conventional pin-hole lens or as an immersion lens for ultra-high resolution imaging. The combination of the upper corrector, sample bias, and clever lens design allows the Verios 460L to image insulating samples with no conductive coating. Conventional SEMs require that the sample either be conductive or be coated with a conductor which can obscure or even modify the details that one is trying to observe at high resolution.

The FEI Verios 460L is equipped with a wide array of detectors. Since the Verios 460L is capable of biasing the stage to 4kV, detectors must be thought of differently than with a conventional SEM. In a conventional SEM with no stage bias detectors are divided into those used to collect secondary electrons and backscattered electrons. With stage bias, low energy secondary electrons are accelerated to backscattered electron energies, so detectors are divided into low energy and high energy electron detectors.

There are two low energy electron detectors. Each detector is dedicated to the two primary imaging modes, with those being low resolution or field free mode and high resolution or immersion mode. The Verios 460L is equipped with a low energy Everhart-Thornley detector (ETD) for use in low resolution mode and a through-the-lens (TLD) detector for use in high resolution mode.

There are three solid stage high energy detectors. The first is the so-called mirror detector (MD), which is mounted inside the objective lens just above the low energy electron mirror for the TLD. The MD tends to show not only compositional contrast but also topographic contrast. The second solid state detector is the in-column detector (ICD), which is mounted in the column approximately 10cm above the MD. The ICD tends to reduce topographical contrast (due to geometric considerations) and highlights compositional contrast. The third solid stage detector, the concentric backscatter detector (CBS) is a retractable detector that is inserted below the pole piece. The CBS detector, as its name implies, has a concentric design and the user is able to select and/or mix up to four different concentric segments. This detector tends to highlight topography.

There is a fourth solid state high energy electron detector that is dedicated to imaging electrons that are transmitted through the sample. If the sample is thin enough, electrons can penetrate through the sample. The STEM detector can be inserted under a sample that is mounted on a TEM grid to observe electrons being transmitted through the sample.