Applications Data Sheet

Variable Pressure Low-Voltage Imaging with Hitachi's S-3000 Series Standard SEMs

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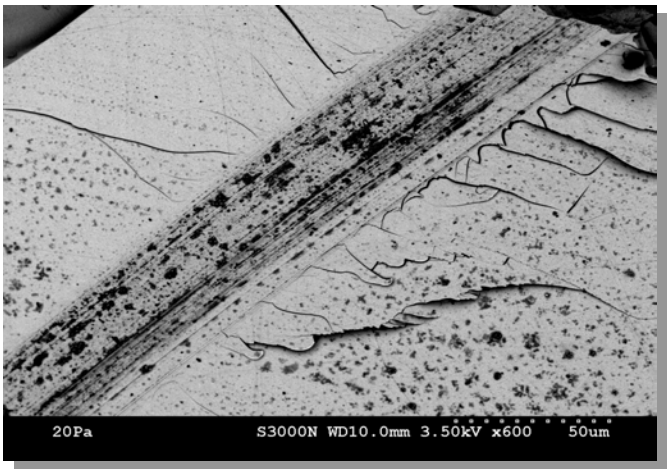
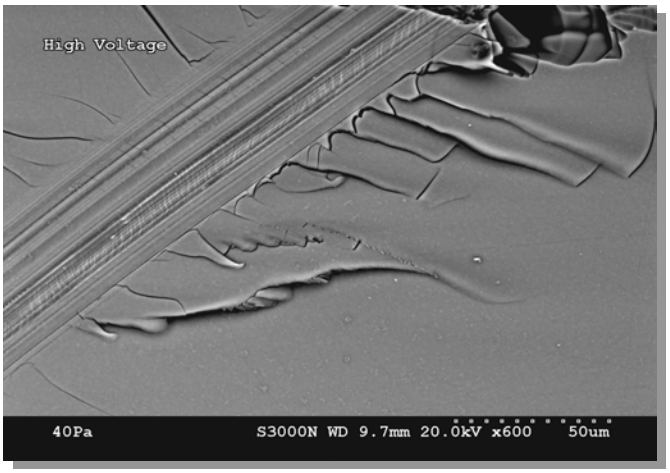
THE COMBINATION OF VARIABLE PRESSURE AND LOW VOLTAGE PROVIDE TRUE SURFACE DETAILS WITHOUT EXPERIENCING CHARGING PHENOMENON.

The Variable Pressure SEM allows observation of non-conductive samples in their natural state, eliminating the need for sample preparation. When imaging in the both the high vacuum or variable pressure modes the use of low accelerating voltages is often preferred over the use of high accelerating voltages. This is because when operating at low voltage, beam penetration is minimized which enables observation of the true surface of the sample. The Hitachi S-3000 series has the ability to operate within the low voltage regime because of the patented Dual Bias circuit which, with a tungsten filament, provides in excess of 100μA of emission current at 5kV and below. With the patented dual bias circuit, all types of samples can be easily imaged in the low voltage mode so that vital surface information can be acquired, even while operating in the variable pressure mode.

Below are two images of an uncoated glass sample. When the two images are compared the loss of surface information in the high voltage image is clearly apparent. Conversely, the lower accelerating voltage image contains true surface information, as evidenced by the dark regions. At 20kV, the beam penetration is greater and yields information from the subsurface. Also note how the fine surface cracks are now visible in the low voltage image.

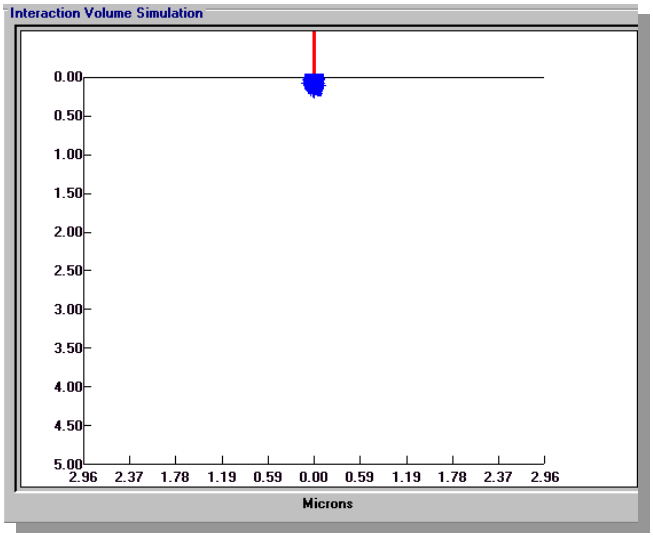


3.5kV

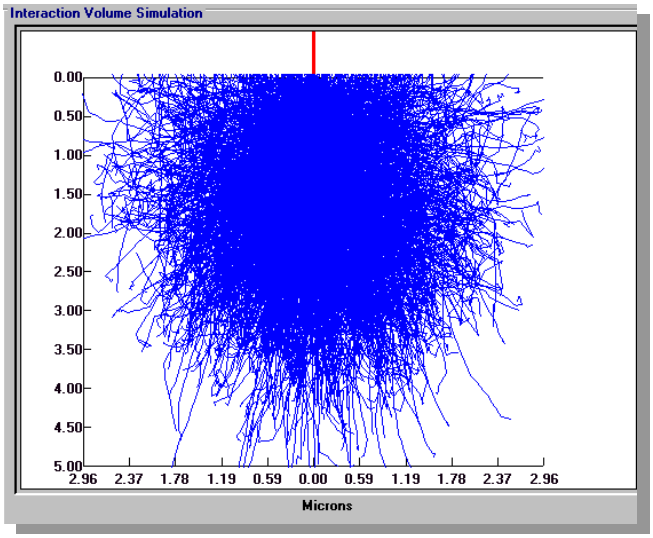


20kV

Beam Penetration



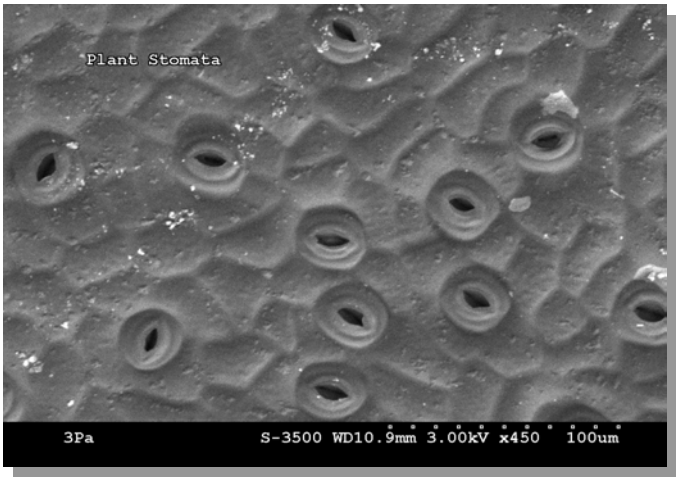
3.5kV Monte Carlo Simulation



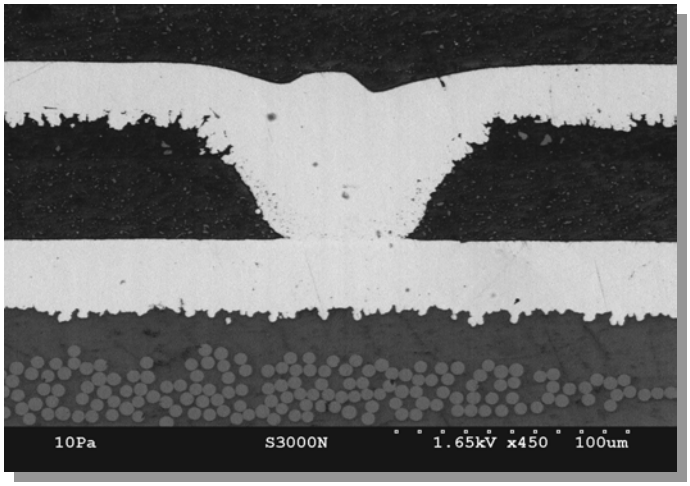
20kV Monte Carlo Simulation

A Monte Carlo simulation for glass (Si) clearly shows a much greater depth of beam penetration at 20kV compared to 3.5kV. Less penetration decreases the interaction volume, which is beneficial for both imaging surface features and when acquiring light element EDS analysis. EDS spectra acquired at low voltage provide more discrete peak separation due to less absorption by the higher energy peaks and over-voltage effects.

Biological and Materials Applications



Leaf Stomata



Printed Circuit Board