Applications Data Sheet

Ultra Low Voltage Imaging
with Hitachi's S-4800 FE-SEM

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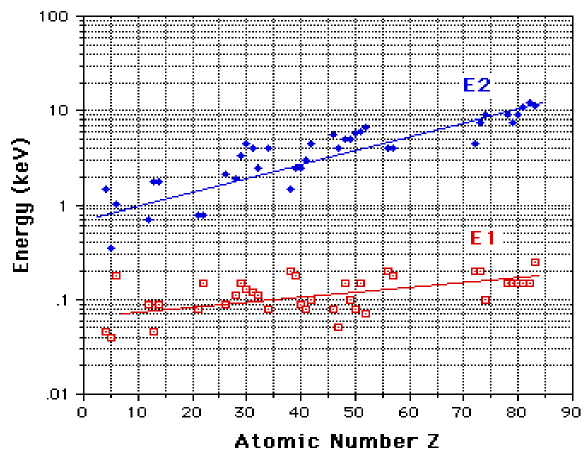
WITHIN THE ULTRA LOW VOLTAGE RANGE SPECIMENS THAT WERE PREVIOUSLY DIFFICULT TO EXAMINE ARE NO LONGER CHALLENGES TO IMAGE.

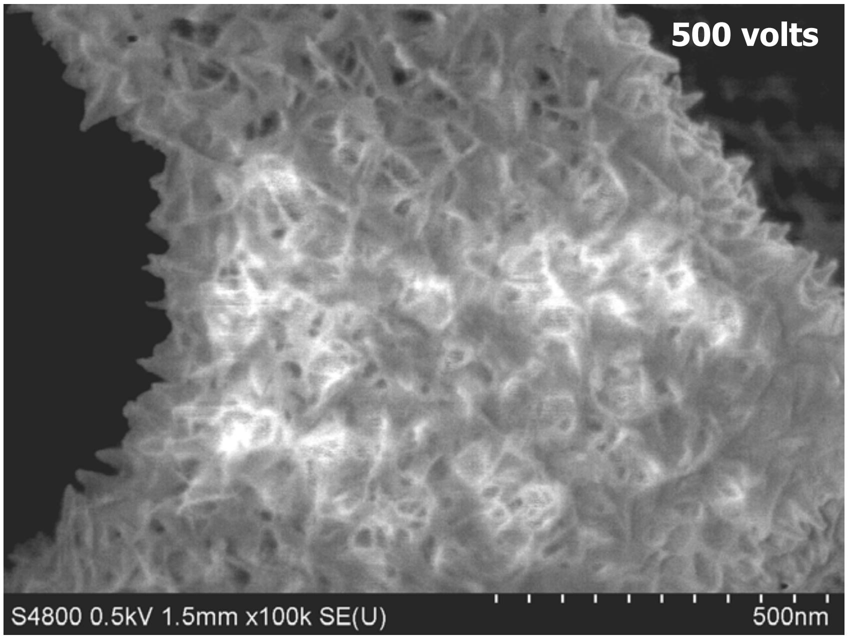
Field emission SEMs are used primarily for their performance at low voltage. The brightness of the source provides the much needed signal for high-resolution secondary electron imaging. Microscopists often work in this region to see such benefits as fine surface detail and minimal specimen charging. The aim of the operator is to attain charge balance; the electrons going into the specimen equal the electrons leaving the specimen. Past work has been done to attain the E_2 or second charge balance position, mainly because the E_1 positions were below traditional accelerating voltage levels.

The Beam Deceleration Technology on the Hitachi S-4800 makes the E_1 position of charge balance within reach. Operating between 100 volts and 2kV while using the Beam Deceleration technology not only achieves the ideal E1 landing voltage (voltage of the primary beam at the sample) but also applies the aberration coefficients of the higher initial accelerating voltage thus resulting in improved resolution.

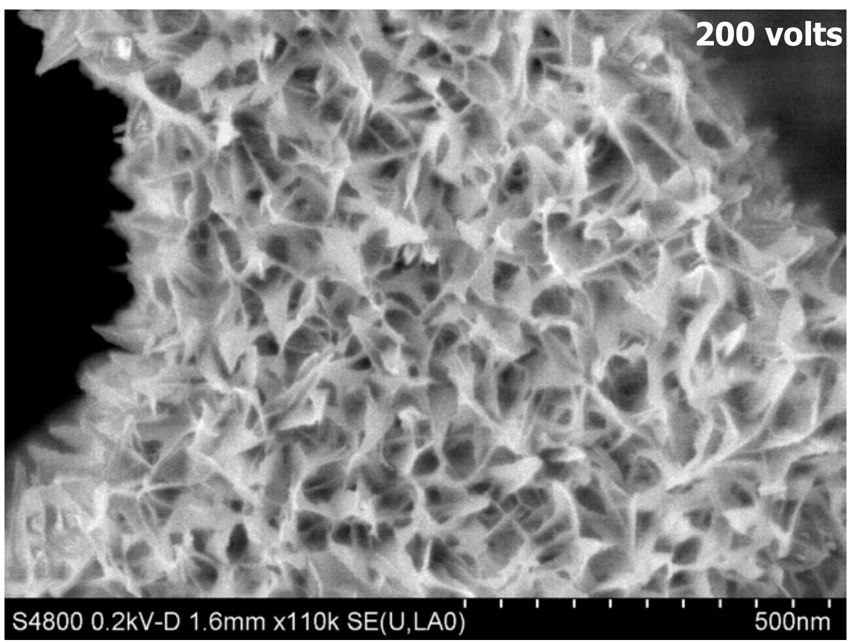


This technique is most useful when imaging non-conductive specimens where charge balance is difficult to maintain. For the example below aluminum oxide sample was imaged at 500 volts (the minimum landing voltage prior to the introduction of the Beam Deceleration technology) and 200 volts (close to the E1 position for the material). An immediate change in the specimen's behavior is witnessed at the lower landing voltage. The specimen does not exhibit charging characteristics and imaging at higher magnifications is possible.

At 500 volts the specimen exhibits charging that distorts the surface information and image contrast. In this situation it is often necessary to average TV rate frames in order to capture an image (poorer signal to noise ratio). Another common step would be to coat the specimen. However, this can obscure fine surface details and takes additional time.



Now, imaging at ultra low voltages (100-500 volts) provides the ideal solution. The 200-volt image below demonstrates a reduction in charging and enhanced surface information without the additional time needed for coating or a compromise in signal to noise. Charge effects no longer obscure the flake-like surface features and a true feel for the surface structure is understood. With the absence of charge the image is captured using a slow scan, high-resolution image collection.



Within the ultra low voltage range specimens that were previously difficult to examine are no longer challenges to image.