

Sample Coating for SEM

Modern day Scanning Electron Microscopes (SEMs) are capable of imaging at ultralow voltages or low vacuum modes to handle even the most non-ideal sample types without the need for extensive sample preparation. Low voltage, with its inherent low beam penetration into the sample, allows us to examine fine surface morphology. The added advantage to low voltage imaging is the ability to look at nonconductive samples and minimize charging artifacts. Low vacuum, on the other hand, allows us to look at and analyze non-conductive and outgassing samples at higher voltages required for other analytical techniques such as X-ray Analysis (EDS/WDS), Cathodoluminescence (CL) or Electron Backscatter Diffraction (EBSD). Thus, we have the tools to analyze many sample types with minimal to no sample preparation. A question often asked is with the versatility of today's SEMs, is there any reason to add a conductive coating when preparing samples for the SEM? And if I add a conductive coating, what do I coat it with? There are a lot of options.

Traditional methods of dealing with nonconductive materials was to sputter coat or evaporate a thin layer of a metal such as gold, gold-palladium, platinum or evaporate a thin layer of conductive carbon on the surface of the sample. Thin layer is typically considered to be between 5-50nm -not thick enough to mask surface morphology but enough to provide a conductive coating to dissipate charging artifacts, any resultant heat buildup and minimize beam damage. For analytical studies such as EDS/WDS, coating a nonconductive sample and working in high vacuum mode allows us to eliminate any confusion that may be associated with beam scatter. So, these coating methods still have their place in our tool box. The question is, which to choose and when?



Sputter coaters are a great option for imaging applications. Adding a metal coating such as gold or platinum allows the user to image a nonconductive sample at higher voltages. In general, higher voltages coincide with a smaller effective beam diameter (higher resolution). A thin metal coating not only provides a conduction path, but a way to dissipate heat buildup and minimize beam damage with beam sensitive samples. These heavy metal coatings also provide a higher secondary electron yield, which can improve signal to noise. One disadvantage may be absorption of low energy electrons and X-rays. This may impact sensitivity of backscatter electron (BSE) imaging especially in areas with low atomic number. Also, the metal X-ray lines could interfere with the X-ray lines inherent to the sample being analyzed. If very high resolution imaging is of interest, the user may be better off with finer coatings and more exotic metals, such as Iridium or Osmium.

Carbon evaporation will also provide a conduction path for a non-conductive sample to be imaged at high voltages. Interfering X-ray signals are not typically an issue and low absorption will allow for better BSE signal to the detector. Therefore, if BSE imaging or X-ray analysis is of interest, this coating method has its advantages.

In summary, if the intention is to perform some analytical characterization such as EDS or intensive imaging with your BSE detector then carbon evaporation is a good choice. For high magnification imaging with low atomic number samples, adding a metal coating has its advantages.