

# Elimination of Electron-Beam-Induced Carbonaceous Contamination in SEMs and the new RGM 10100 NIST Contamination Testing Artifact

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Electron and ion beam-induced contamination could be a severe problem of scanning electron microscopes. The carbonaceous material deposited in a dynamic process of adsorption and desorption at the irradiated area can easily disturb imaging and lead to erroneous measurement results. The sources of contamination are usually both the SEM and the sample. Cleaning of the SEM can be carried out with a low-energy (oxygen) plasma cleaning process using commercial devices [1], but without a for-sure-clean sample, it is not possible to determine whether potentially time-consuming cleaning of the SEM is indeed necessary. The RGM 10100 sample with its associated cleaning and evaluation procedures, combined with appropriate cleaning processes offer an effective solution for this problem.

Figure 1 shows three levels of SEM cleanliness. The energetic primary electrons can “purge” the center of the sample from carbonaceous contaminant molecules. The center brightening is due to slight oxidation caused by electron irradiation at 40 times the typical dose.

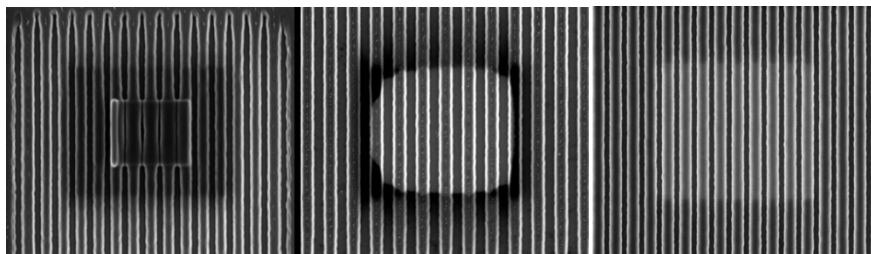


Figure 1 1 keV landing energy, 43 pA SEM images of RGM 10100. Left with a dirty SEM after 10 minutes of continuous electron beam bombardment at 635 nm horizontal field width (HFW). With a cleaner SEM the center might stay clean (middle). There is no contamination with a clean SEM even at 40 times the typical dose (right). The HFW is 2.54  $\mu\text{m}$  for all images.

RGM 10100 can be cleaned with acidic piranha solution and can stay clean for months in a semiconductor grade plastic container. The necessary SEM cleaning time, depending on the cleanliness of the SEM, varies from 10 minutes to a couple of days. It is common that the contamination “comes back” after some time. As the SEM gradually becomes free of the source molecules of contamination, the time between needed cleanings could increase to months. RGM 10100 is available from the NIST Office of Reference Materials.

\*Certain commercial entities, equipment or materials may be identified in this document in order to describe an experimental procedure or concept adequately. Such identification is not intended to imply recommendation or endorsement by, nor is it intended to imply that these are necessarily the best available for the purpose.

[1] <http://evactron.com>, <http://ibssgroup.com>, <http://www.piescientific.com>

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