Charged particle beam-induced contamination has been one of the most persistent problems since the beginnings of electron and ion microscopy. Contamination manifests itself as a gradual buildup of carbonaceous material on the surface of the sample in the vicinity where the electron or ion probe excites the sample, which results in characteristic dark patterns. Contamination changes the sample itself and the number, trajectory, and energy of the electrons or ions leaving the sample, and consequently it makes repeatable quantitative measurements and achieving the best spatial resolution difficult or impossible. Fortunately today, with wet and dry cleaning processes, obvious charged particle beam-induced contamination can largely be eliminated\(^1\)-\(^7\).

We are reporting here on the various processes that are effective in cleaning both samples and the instrument. The cleaning processes followed by several minutes of electron bombardment leads to even better, possibly ultimate sample cleanliness. The procedure not only allows for more repeatable quantitative electron and ion microscopy measurements and material deposition and milling, but also makes it possible to achieve higher imaging resolution than otherwise would be possible.

**Contamination Ruins the Sample and Resolution**

Contamination-free SEM

Using piranha solution, low-power oxygen plasma, hydrogen plasma, helium plasma and laser beam cleaning, contamination can be essentially eliminated. Note the increased secondary electron yield after electron bombardment

**Contamination-free SEM**

Milling in dirty HIM leaves the milled areas of the sample unusable. Much better pattern can be obtained after cleaning the HIM with oxygen by Evactron Model 45 20 W plasma cleaner

**Meeting the NIST contamination specification means the instrument is clean.**

On clean samples a few minutes of electron bombardment results in ultimate secondary electron yield and in the highest attainable spatial resolution. Both these are indispensable for nanometer-scale imaging and measurements.

**References**


*Certain commercial equipment is identified here to adequately describe the experimental procedure. Such identification does not imply recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that the equipment identified is necessarily the best available for the purpose.*