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https://doi.org/10.1017/S1551929500050501 Published online by Cambridge University Press

ELECTRON MICROSCOPIST

Research Scientist Level (Full time)

.We are looking for a motivated, mature and responsible individual to join a state-of-the-art Federal funded biomedical research laboratory. Flexible job hours in a challenging and stimulating research environment. Willing to train for specialized tasks.

Minimum qualification: B.S. in biology with experience in specimen sectioning and electron microscopy. Preferred qualification: B.S. in biology with experience in serial sectioning and electron microscopy.

Responsibilities:

1. Embedding various biological specimens for transmission electron microscopy analyses.
2. Thin and thick (serially) sectioning of plastic embedded specimens.
3. Scanning and photographing sections with the EM
4. Conducting 3D analyses (tomorgraphy).

Salary commensurate with experience. Interested parties contact:

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Advanced Light Microscopy Core Unit
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Albany, NY 12201-0509

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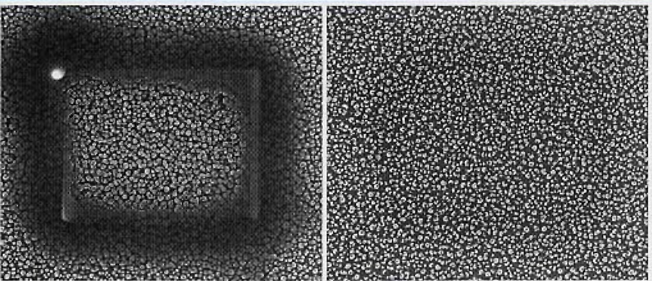
"The Evactron device can significantly reduce contamination in the SEM."



A silicon "grass" sample irradiated for 10 minutes before (left) and after (right) the use of Evactron SEM-CLEAN device. 50kX - From *Active Monitoring and Control of Electron Beam Induced Contamination* by A. Vladar, M. Postek, & R. Vane., SPIE Microlithography Conference. Feb. 2001.

EVACTRON SEM-CLEAN "plasma" Cleaning

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Comments on Quantifying the Results of Electron-Probe Analysis of a Gold-Tin Solder

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First, it is important to know whether the objective of the analysis is to measure the total amount of the two metals in the assembly as a whole, or to measure their proportions in each of the different areas: the tin solder, the intermetallic layers and so on. The purpose to which the results are to be put is also important. To some extent the answer depends on knowing this, as a biased but highly repeatable measure of something is often useful for internal purposes.

For Au/Sn intermetallic compounds which have quite specific compositions, the absorption/enhancement effects will be different than for a low-concentration solid solution of either of the metals in the other. Without a standard comprised of a known intermetallic phase, the results could be consistent (that is, the measure might be used as a means of process control) but not very accurate (as compared with the absolute amounts present). Another frequently overlooked problem with quantifying the results of electron probe analysis of a multiphase alloy is that the size distribution of immiscible but intimately mixed phases may change due to process variables (*e.g.,* thermal history) even though the total proportion of the metals remains the same. The micro-environment (matrix effect) experienced by an emitted x-ray will depend on its probability of passing through the same material or a different phase on its way to reaching the detector. Obviously this can be affected by the grainsize of a eutectic mixture.

Whether the three dimensional sample is to be sectioned into a planar surface for analysis or examined as received is also important. Another frequently overlooked problem is that of x-rays emitted through secondary interactions with structures that are not illuminated by the beam but which are "visible" within the detector collimator's view. A planar cross section presents the least chance for interference of this kind. On the other hand, a gold-metallized surface projection that resides next to your solder structure could be a source of enhanced Au-m x-rays produced through secondary fluorescence by the Sn-l x-rays under the beam. Even though secondary emission is not a very efficient process, the number of Sn x-rays fluorescing the adjacent gold is much higher than the number that happen to be emitted in the direction of the X-ray detector. Meanwhile the X-ray detector is looking at the whole scene indiscriminately.

There are two main points. The first has to do with understanding the way texture in a multiphase system, especially a eutectic, can add variability to even the simplest system with only two components. A sub topic of that is to appreciate that in this particular system one or more of the phases may be intermetallics with a precisely fixed stoichiometry while another may be nearly a pure element - but that due to lack of equilibrium in a rapid process like flip-chip bonding there could be appreciable solid solution of the second element in this phase.

The second point is a more general caveat about an oversight which I have seen ruin a lot of analyses of industrial products- the failure to realize that a substantial spectral contribution may be coming from something that is not within the rastered area but which is in the much larger field of view of the detector. The best (and most ridiculous) example that I have seen first hand is the following:

Silver-filled epoxies have often been used to attach silicon semiconductors to metallized substrates for hybrid microelectronic assemblies. Occasionally, due to traces of contamination, bizarre recrystallized needles of silver, shaped like sword blades, grow up out of the silver epoxy as much as 100 micrometers, often in clusters. Heat due to high operating temperatures exacerbates the problem in susceptible material. The great danger is that if these detach, they are long enough to short out closely spaced conductors on which they might land. The silver crystals often acquire a trace of silver sulfide on their surface once exposed to the atmosphere due to the affinity of these elements, but that is extraneous to the problem. I have seen a qualitative microprobe analysis suggest that these crystals are comprised of nearly equal amounts of silver and silicon but this is illusory - all the silicon response is secondary fluorescence from the nearby side of the semiconductor chip. The experiment geometry is typically like that of a pedestrian walking on the sidewalk along a high-rise building. The analyst zooms in on the pedestrian (silver crystal), rastering an area just large enough to include him for a good photo. Then the analyst puts the beam in spot mode on the pedestrian's chest and collects a spectrum. The X-ray detector records a moderate count rate of silver X-rays - that tiny fraction of those emitted which are within the small solid angle that is subtended by the detector. The rest, the vast majority, go elsewhere. To one side of the pedestrian, they bombard the nearby building wall (silicon) which is fully within the view of the detector. In this geometry, nearly half the emitted silver X-rays will strike the silicon. X-ray fluorescence is relatively inefficient, one often hears figures of 100:1 for the ratio of excitation to fluorescent radiation, although it depends greatly on the relative energies. However, this low efficiency is offset by the analysis geometry that is heavily biased in favor of structures that are not even within the field of view once the analyst has zoomed in on the feature of interest. The majority of the silver X-rays strike the silicon "wall". From the detector's perspective the X-ray "image" consists of a tiny bright spot of primary silver x-rays, against a dimly glowing "wall" of secondary silicon X-rays. To carry the analogy to the extreme, one might think of the X-ray detector as a night time security camera, high above an unlit street, with no zoom lens, recording a pedestrian carrying a lantern which also illuminates the building, the sidewalk, the spilled trash bin, *etc.* This indiscriminate "camera" faithfully records the entire scene irrespective of the observers intent to scrutinize the pedestrian alone.

This happens because there is often a great deal of attention paid to subtleties of the effective emission volume while potentially greater (and more easily avoided) effects such as I have described above go unrecognised. ■

Research Professional in Electron Microscopy

Center for High Resolution Electron Microscopy
Arizona State University

The Center for Solid State Science seeks applicants for the position of Assistant/Associate/ Senior Research Professional. This appointment is a state-funded Academic Professional position on a year-to-year basis. Essential job functions of this position include: design and engineering of electronic circuits for analog and digital functions; working closely with faculty and students to design and manufacture items for research and development; testing circuit functions to the component level using direct and indirect trouble-shooting methods for failure diagnosis; and diagnosing and repairing vacuum and mechanical systems

Required Qualifications: Master's degree in physical or engineering sciences and five years of experience in electronic repair and maintenance of analytical equipment; or Bachelor's degree in physical or engineering sciences and 8 years of experience in electronic repair and maintenance of analytical equipment. Associate and Full Research Professional ranks also require a Doctorate degree in related area and/or additional extensive experience appropriate to rank.

Desired Qualifications:

- Previous experience with electron microscopes
- Experience with low and high power distribution systems
- Demonstrated working knowledge of electron mi croscopy maintenance and repair

Further information about the Center for High Resolution Electron Microscopy can be found at: www.asu.edu/clas/csss/chrem.

Applicants must submit a cover letter, resume/vitae with names, addresses, phone numbers and email addresses for three professional references to: CSSS Research Professional Search Committee, Center for Solid State Science, PO Box 1704, Arizona State University, Tempe Arizona, 85287-1704. Application deadline is January 28, 2002, or each Monday thereafter until position is filled.

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https://doi.org/10.1017/S1551929500050501 Published online by Cambridge University Press