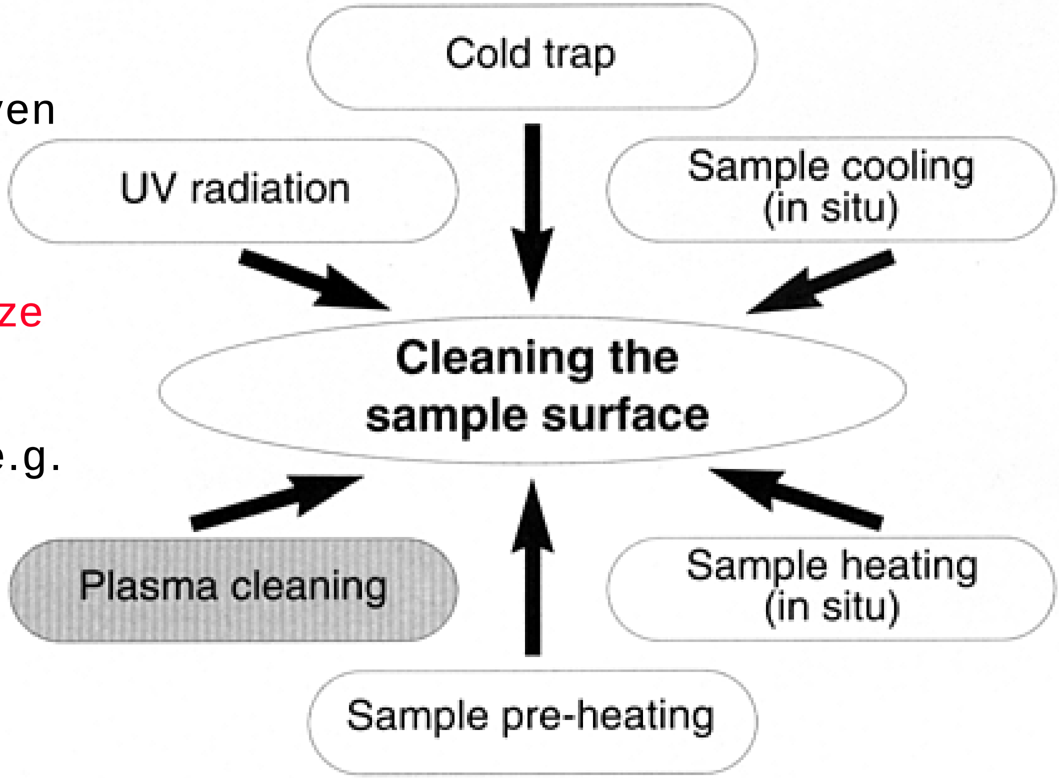
HITACHI
Inspire the Next

Sample Preparation

Cleaning samples

- » Do not use organic solvents as these are always contaminated, even when fresh ‘electronic grade’
- » Never, never, use squeeze or spray bottles
- » Use detergents instead e.g. Alconex ‘Detergent 8’
- » Carbon Dioxide ‘snow’ cleaning -no residue and good solvent action www.co2clean.com

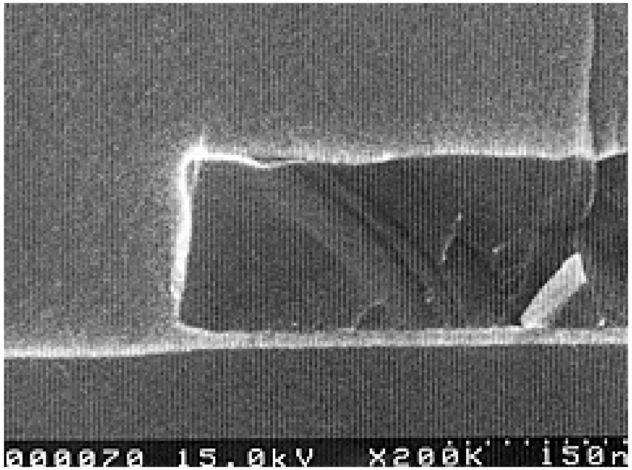


Options available

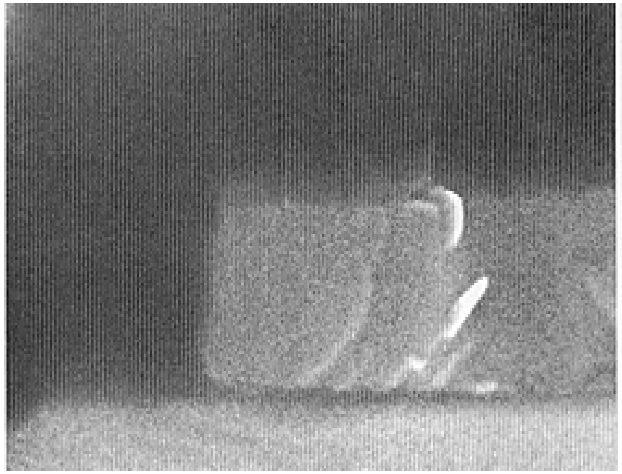
Storing Samples

- As soon as a specimen is prepared for observation it begins to get dirty again
- Even storing the sample in a vacuum dessicator will not prevent the growth of surface contaminant films because the source of the problem is carried in by the specimen itself
- Remedial action is therefore required

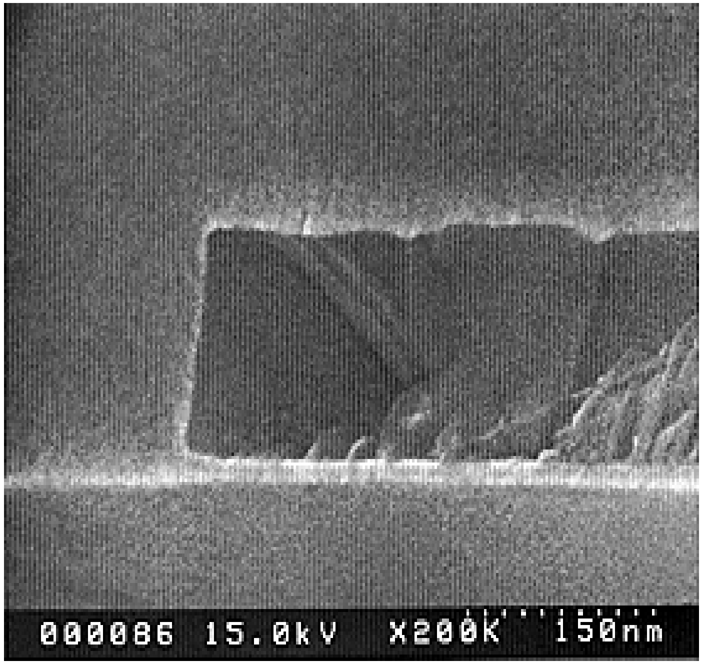
As prepared



After one week



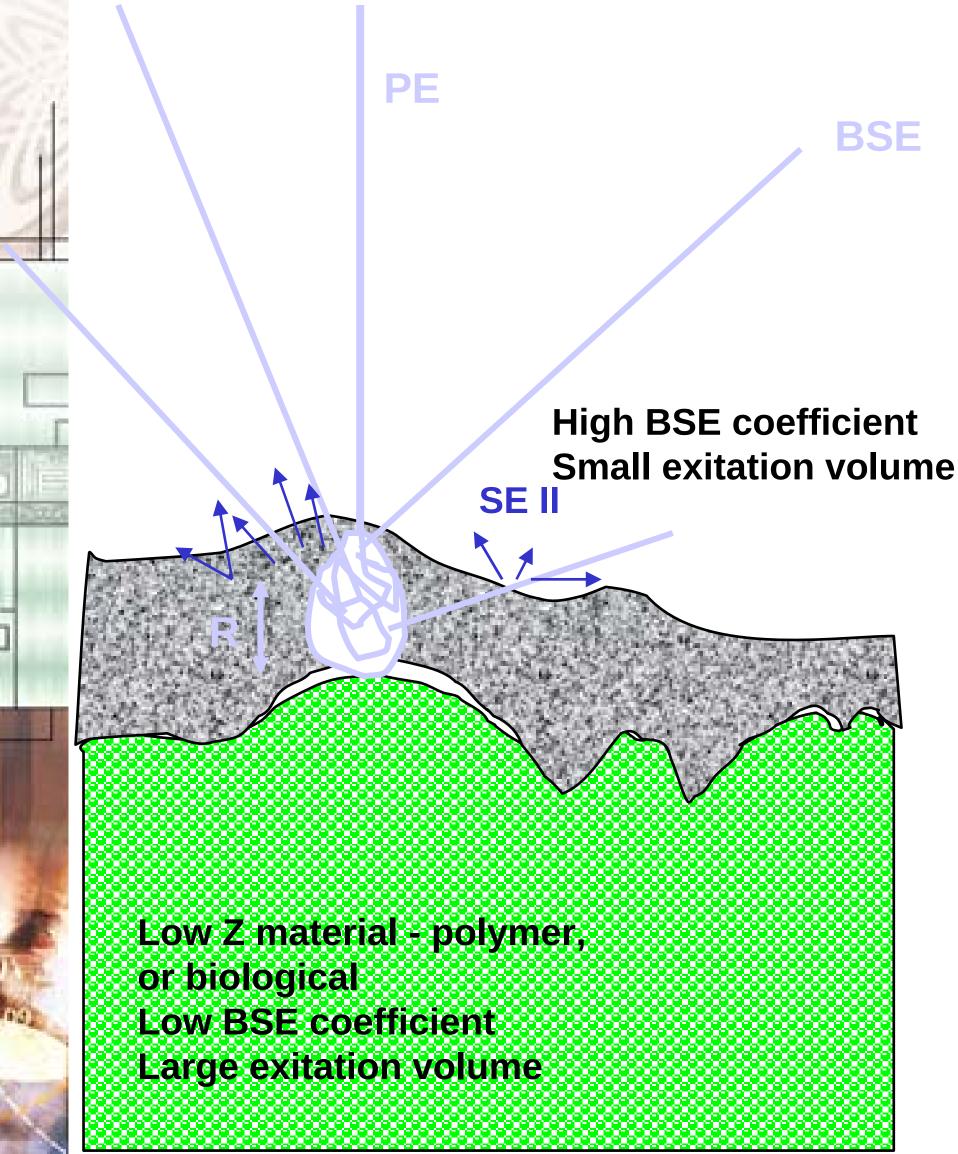
Plasma cleaning



Same sample after plasma cleaning

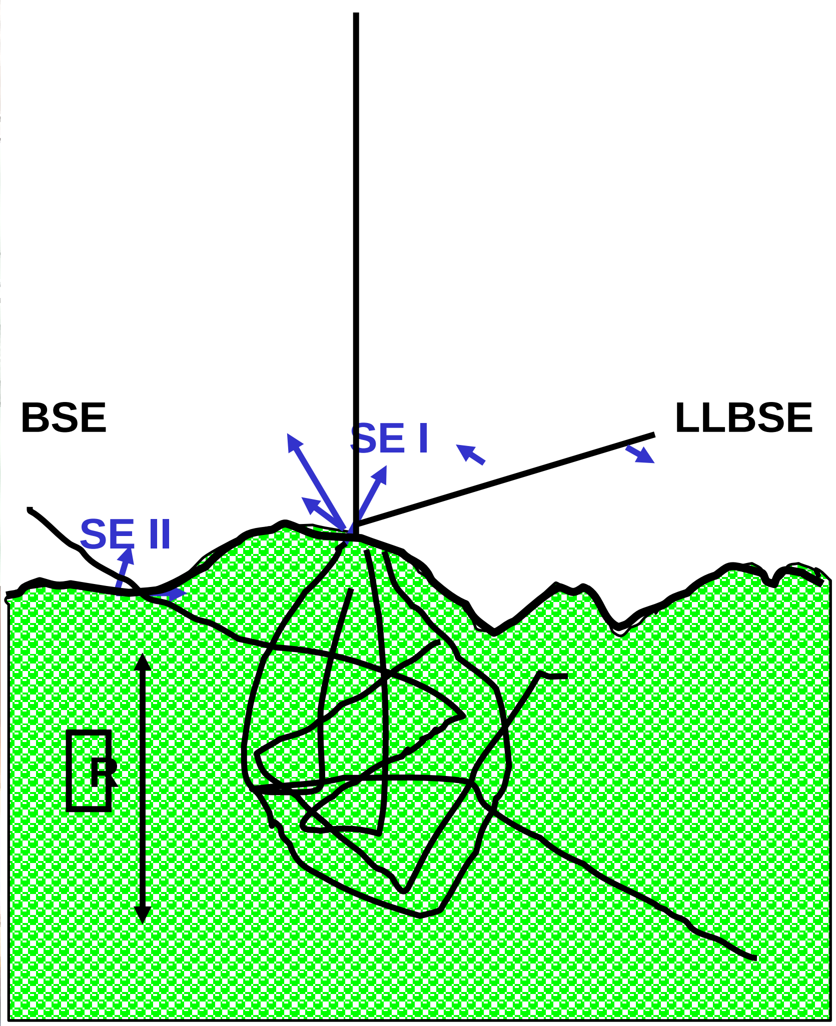
- Plasma cleaning provides a rapid and efficient way of removing the build-up of surface contaminants and restoring the sample to a pristine condition
- Small plasma barrels are now available at competitive prices

The right and wrong way to coat



- Coatings can be THICK or THIN, particulate or smooth
- Coating are usually metal layers of a high Z material such as Cr, Ta, W, Pt, Au
- With a THICK (20-50nm) coating the beam interaction occurs mainly within the coating Layer
- The SE-signal is then SE2 (converted BSE)
- The topographic resolution is limited by the thickness of the metal coat and the SE II range (i.e ~mm)

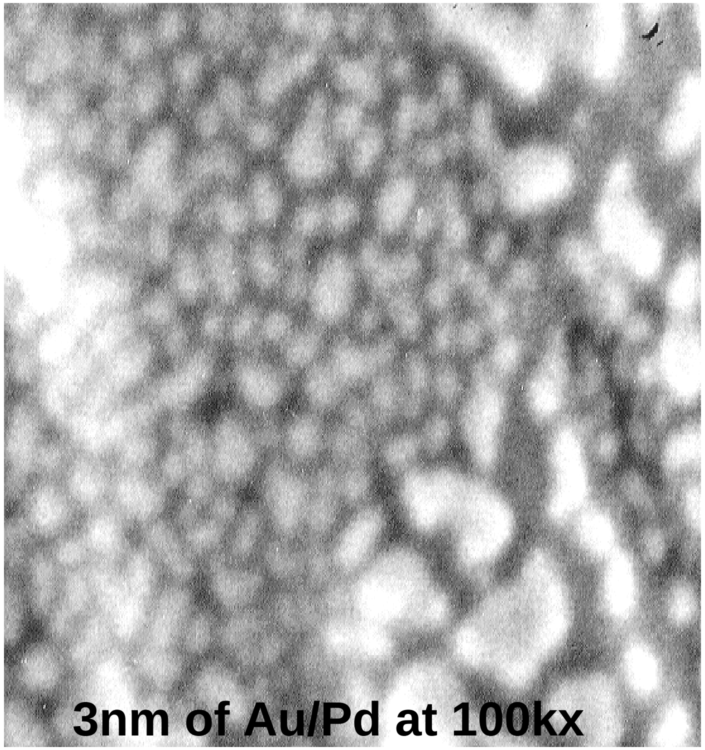
The Right way to coat



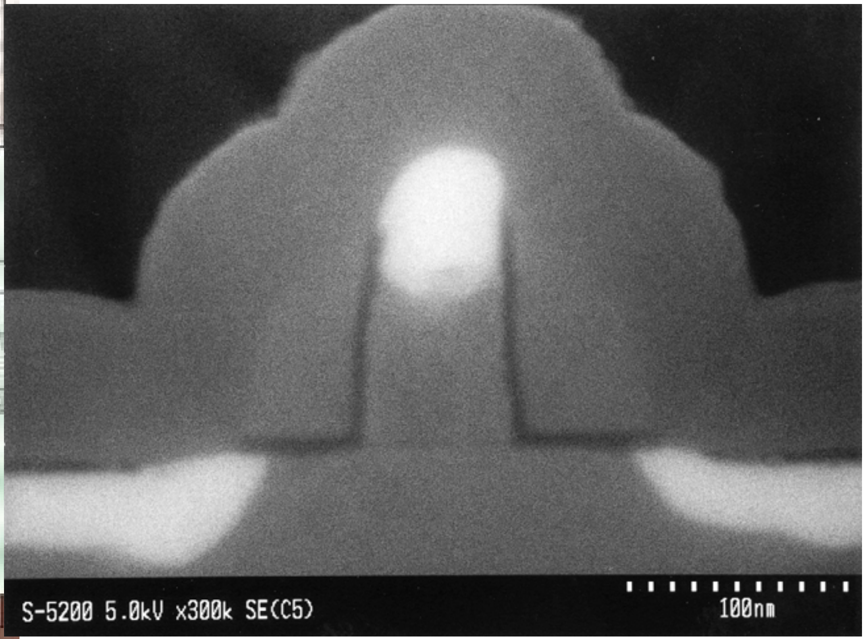
- Use a THIN film
- The beam interaction is now mainly in sample
- The SE-signal is SE I and there is very little SE II from the metal layer..
- Little signal contribution from specimen
- Topographic resolution is now only limited by thickness of the metal coat and the diameter of the electron beam.
- SE produced beneath the metal layer cannot leave the specimen

Particulate Coatings

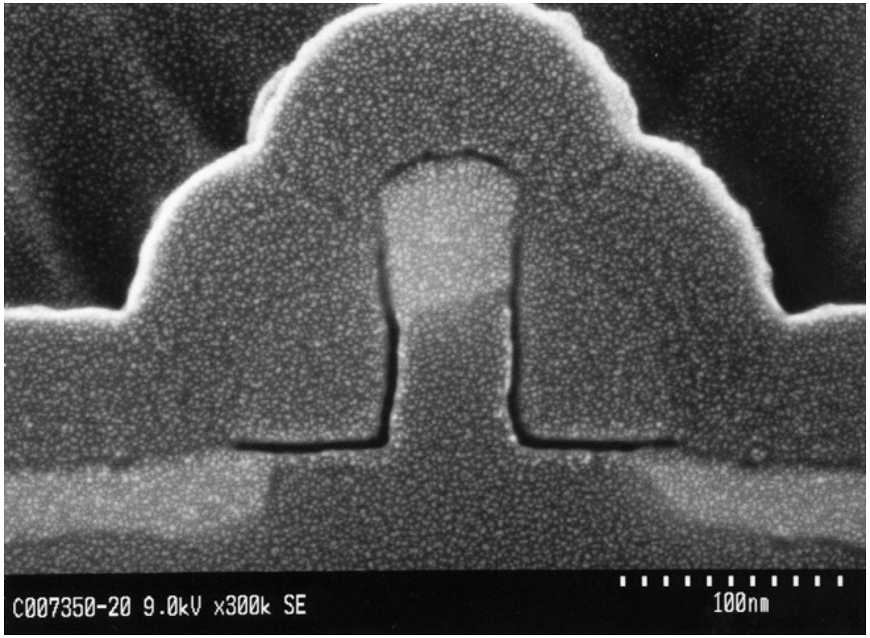
- Au produces very big particles (30nm)
- Au/Pd, Pt, and W make much smaller (1-3nm) particles
- These have a very high SE yield and can be deposited in a sputter coater
- Coatings are stable
- Good below 100kx but can be useful even at higher magnifications..


3nm of Au/Pd at 100kx

UHR SEM Coating Results



Uncoated



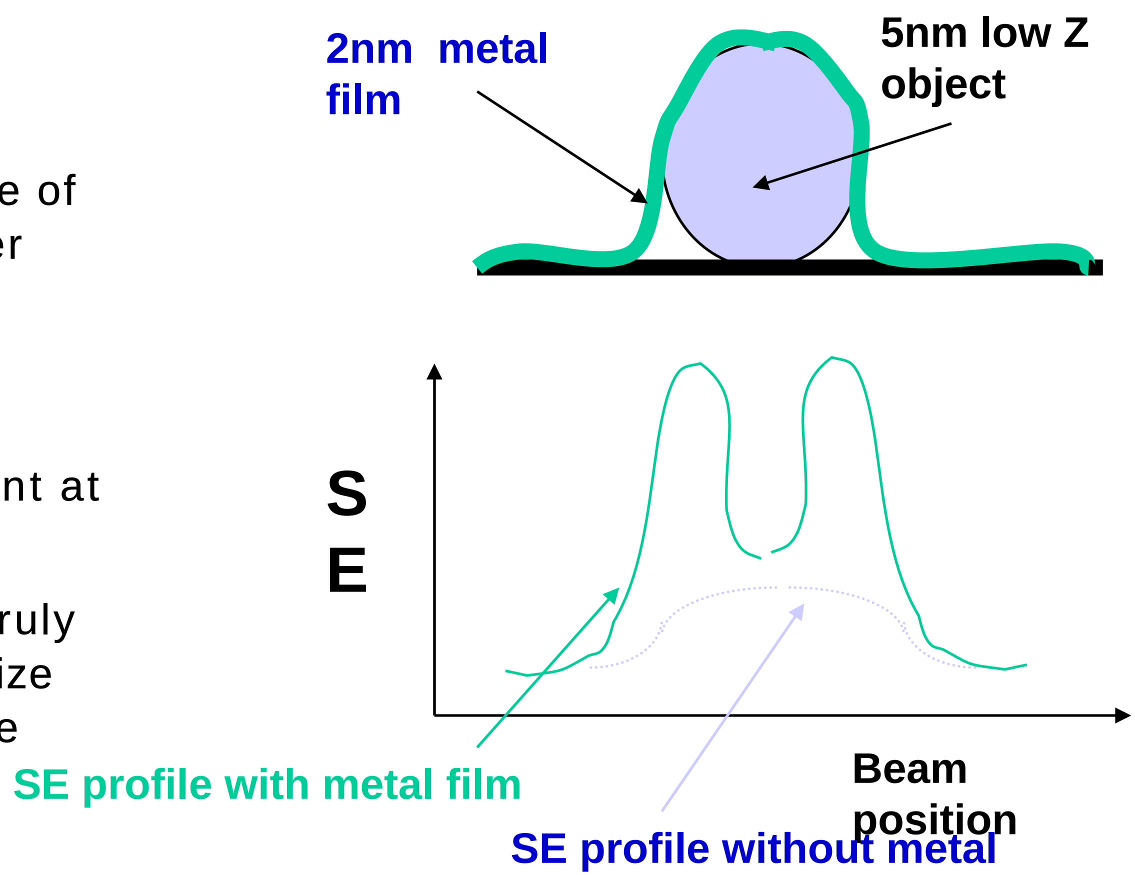
Pt coated Hitachi S-5200

Even at higher magnifications note the benefits of a reduction in charging and the gain in image contrast and detail. The fine grain permits accurate focus and stigmation. Resolution ~ 1.3nm

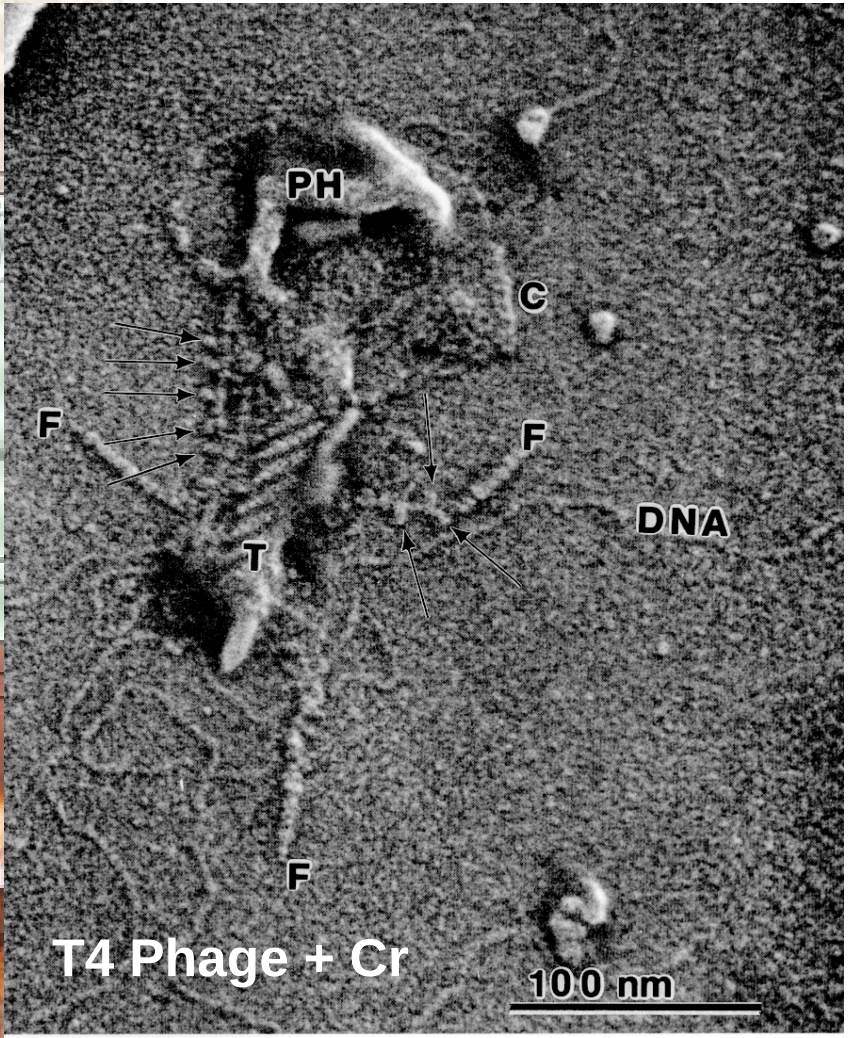
Courtesy Bryan Tracy AMD

Metal builds contrast

- All of the SE signal comes from the film layer
- The resolution will be of the order of the layer thickness
- The mass thickness effect gives extra contrast enhancement at the edges
- The feature is now truly ‘resolved’ since its size and shape are visible once more



Cr coatings



- Cr films are smooth and without structure even at thicknesses as low as 1nm
- The mass thickness contrast resolves edges and make the detail visible down to a nanometer scale
- The high SE yield of the Cr improves the S/N ratio
- However these coatings are not stable - so use Cr coated samples immediately after they have been made

Courtesy of Martin Müller
and Rene Herrmann, ETH Zürich

Coating Summary

- Coatings are an essential part of the technique of high resolution SEM because they generate interpretable contrast, improve resolution, and enhance the S/N ratio
- Thin coatings are better than thick coatings - do not make your sample a piece of jewelry
- Below 100kx particulate coatings are superior because of higher SE yields
- Above 100kx use chromium or titanium unless the visibility of the grain is a help rather than a hindrance
- Carbon is a contaminant not a coating unless it deposited by an ion sputter tool