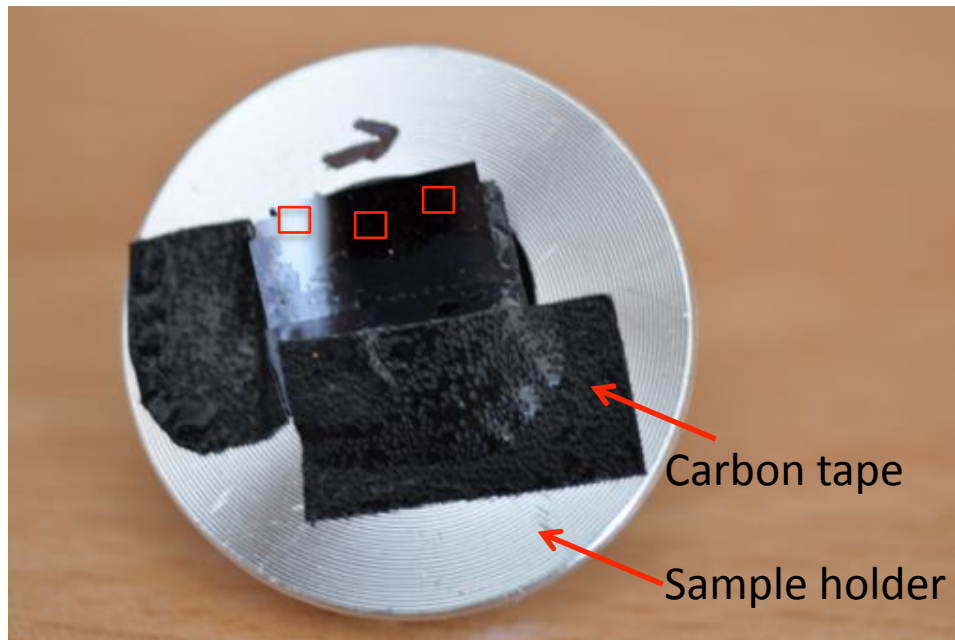




# (1) SEM Study of bent silicon

- Using the low power SEM at QMUL's NanoVision.
- Small sample of bent silicon.
- Radius of curvature is 25mm.
- Sample size  $\sim 11 \times 11 \text{mm}$

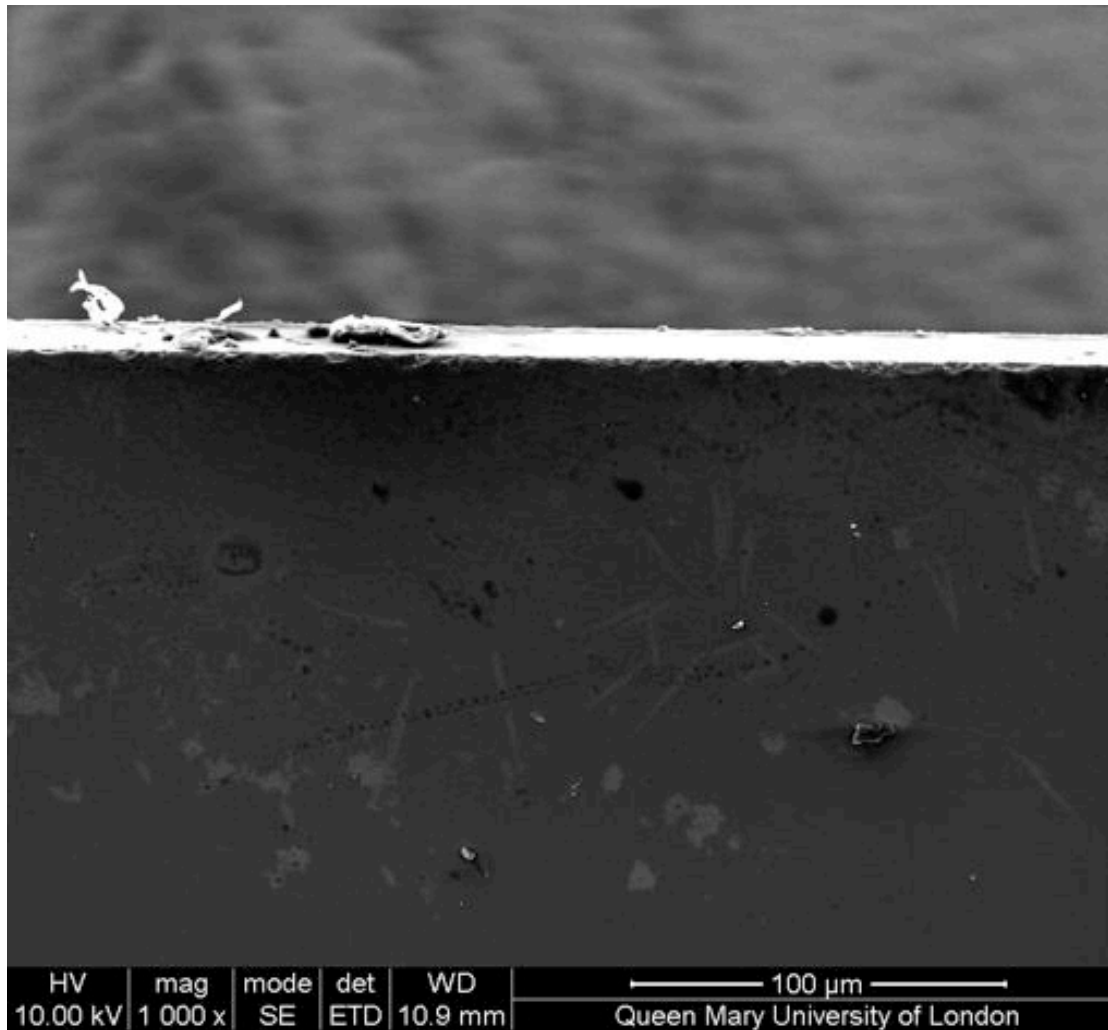


Three areas inspected:  
Left  
Middle  
Right  
+ the edge, just for curiosity



# Edge of a die

- As seen with x1,000 magnification.



## Notice:

chipping visible at the edge  
(from the dicing procedure)

While the edge is mostly well defined, there are burrs that are left on the silicon after the dicing procedure (as shown).

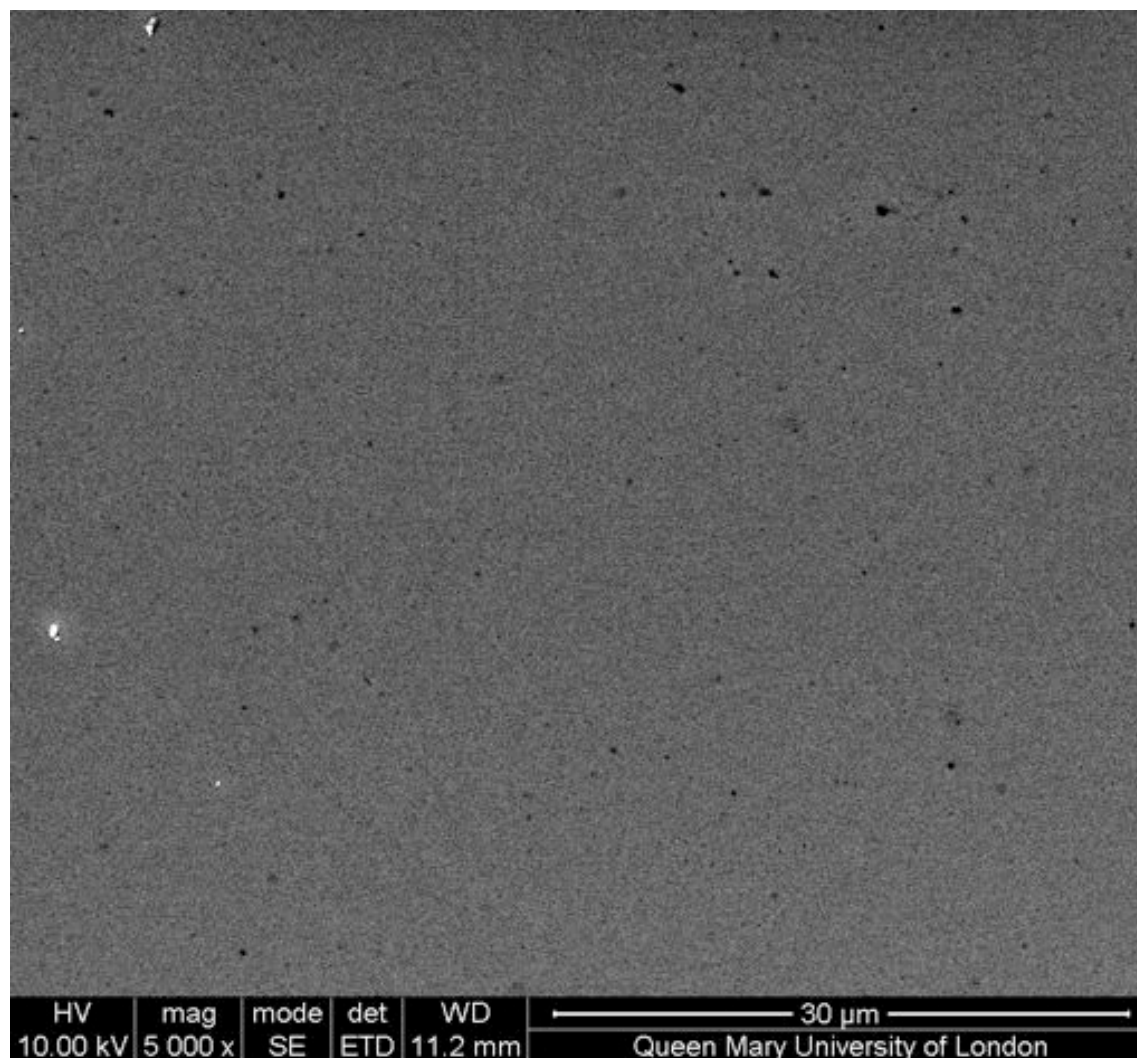
Some surface marks for the first few 00 um a the edge.

Some dark spots near the edge.



# Left side of the sample

- As seen with x5,000 magnification.



Some dark spots on the surface.

These correspond to low density regions (pot holes?).

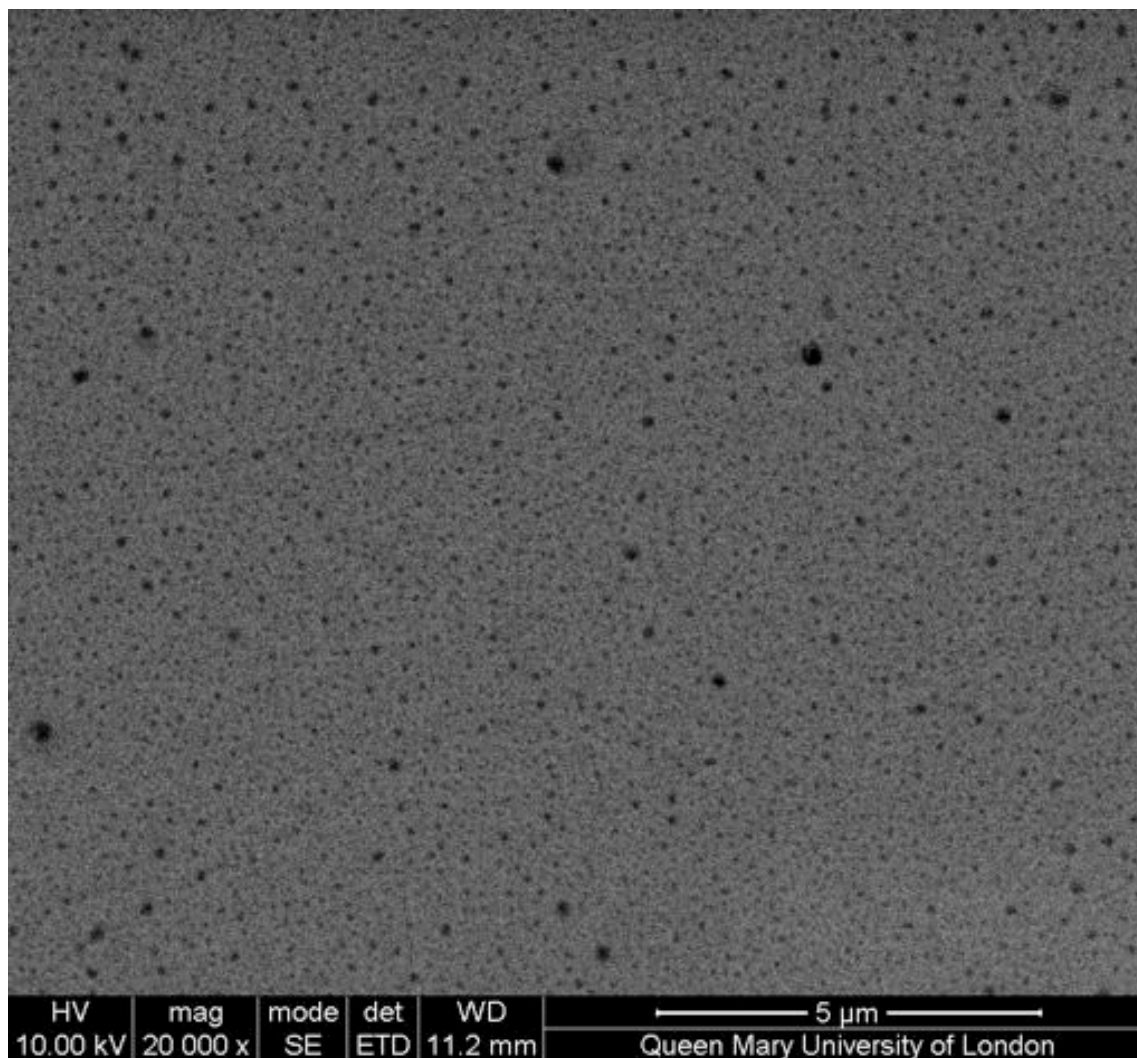
Density (and size) larger toward the top (i.e. toward the edge) of the sample.

Bright spots correspond to dust on the sample.



# Left side of the sample

- As seen with x20,000 magnification.



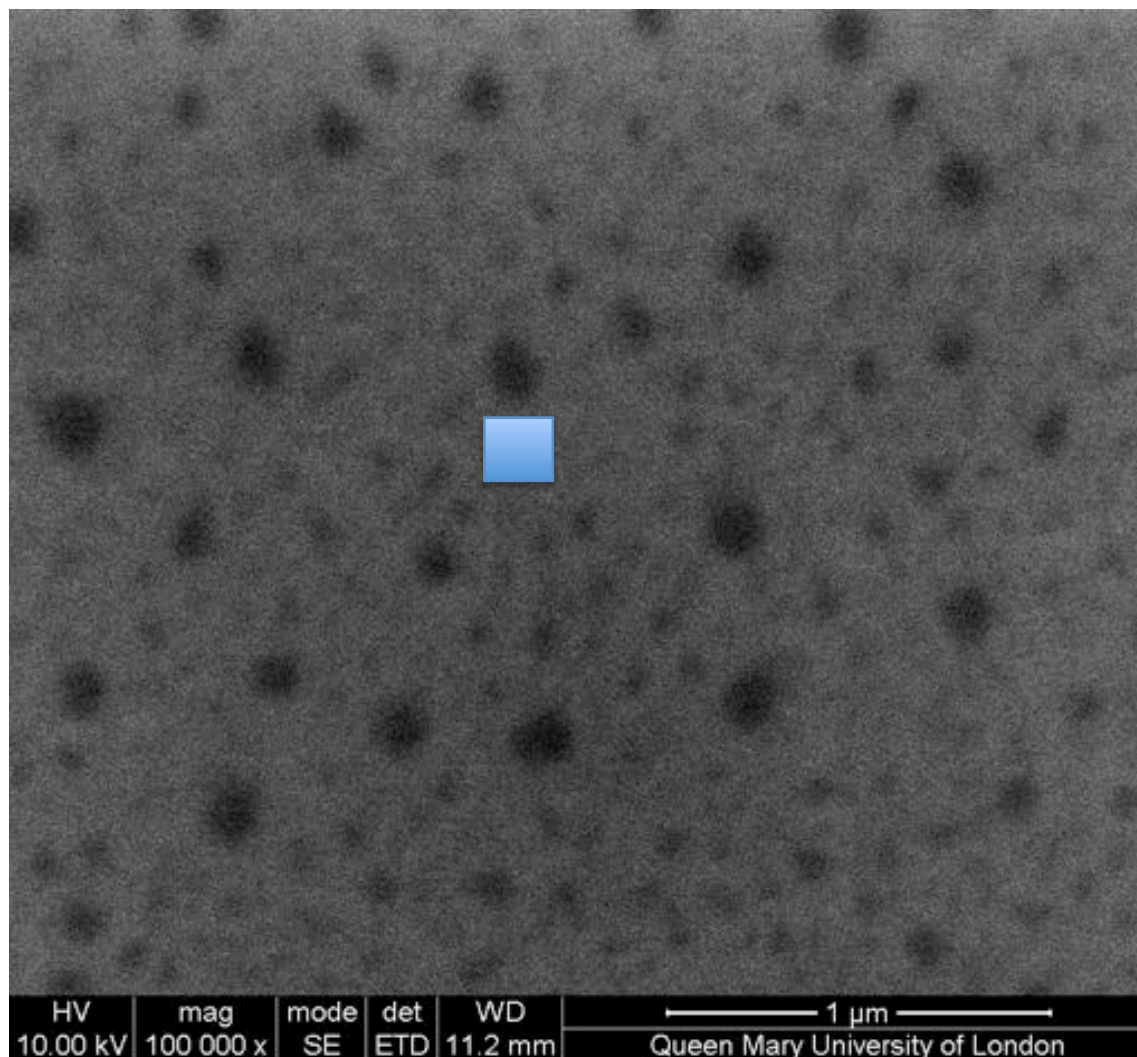
Zooming in we see lots of dark spots: not a good sign.

Also see some lines (probably corresponds to the scratches near the edge that we saw on the first SEM image).



# Left side of the sample

- As seen with x100,000 magnification.



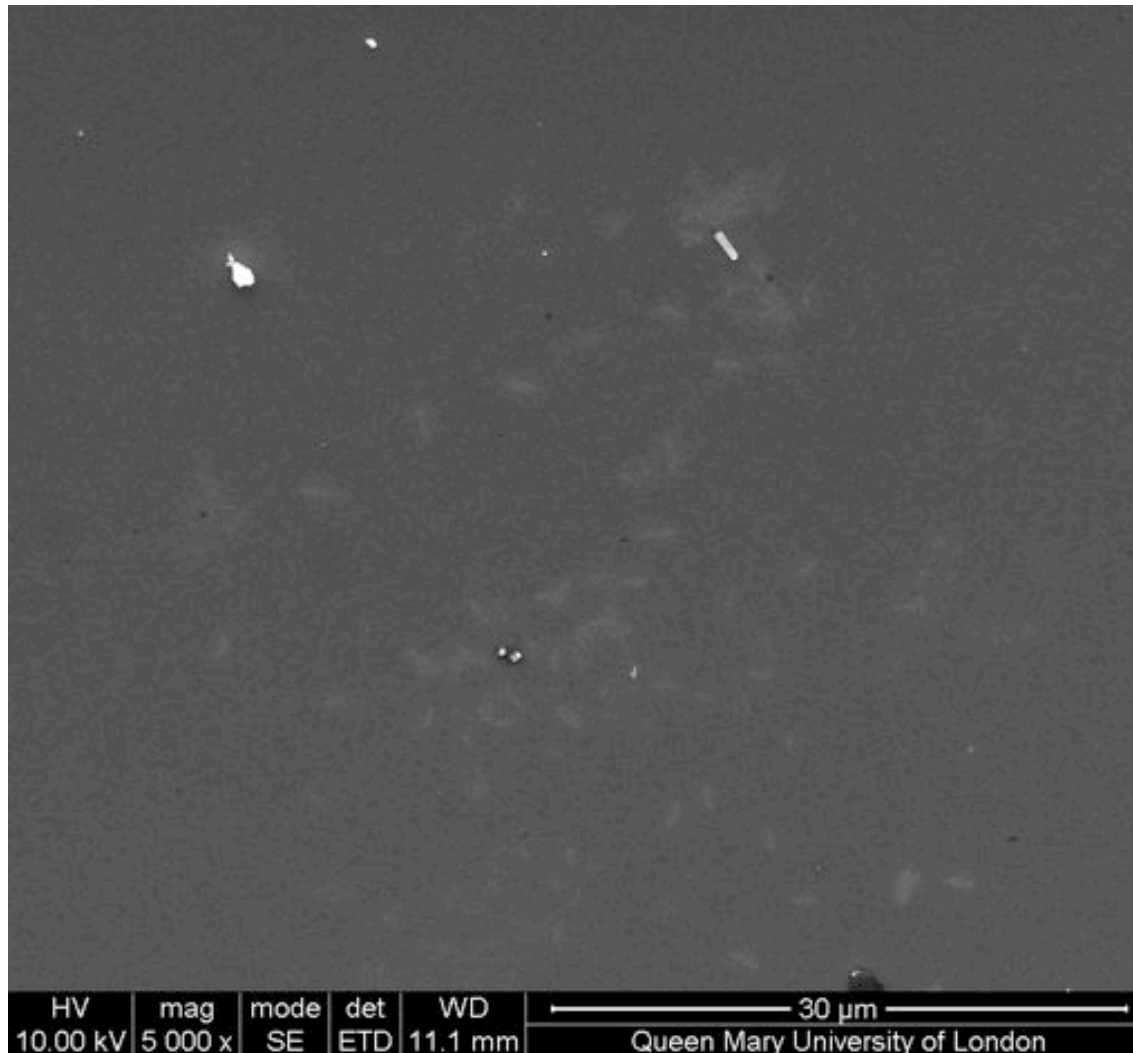
And the pattern seems to repeat itself.

Note actually that the feature size of 180nm on an INMAPS device is comparable to the size of the large holes.



# Middle of the sample

- As seen with x5,000 magnification.



Bright spots on the surface is dust on the sample.

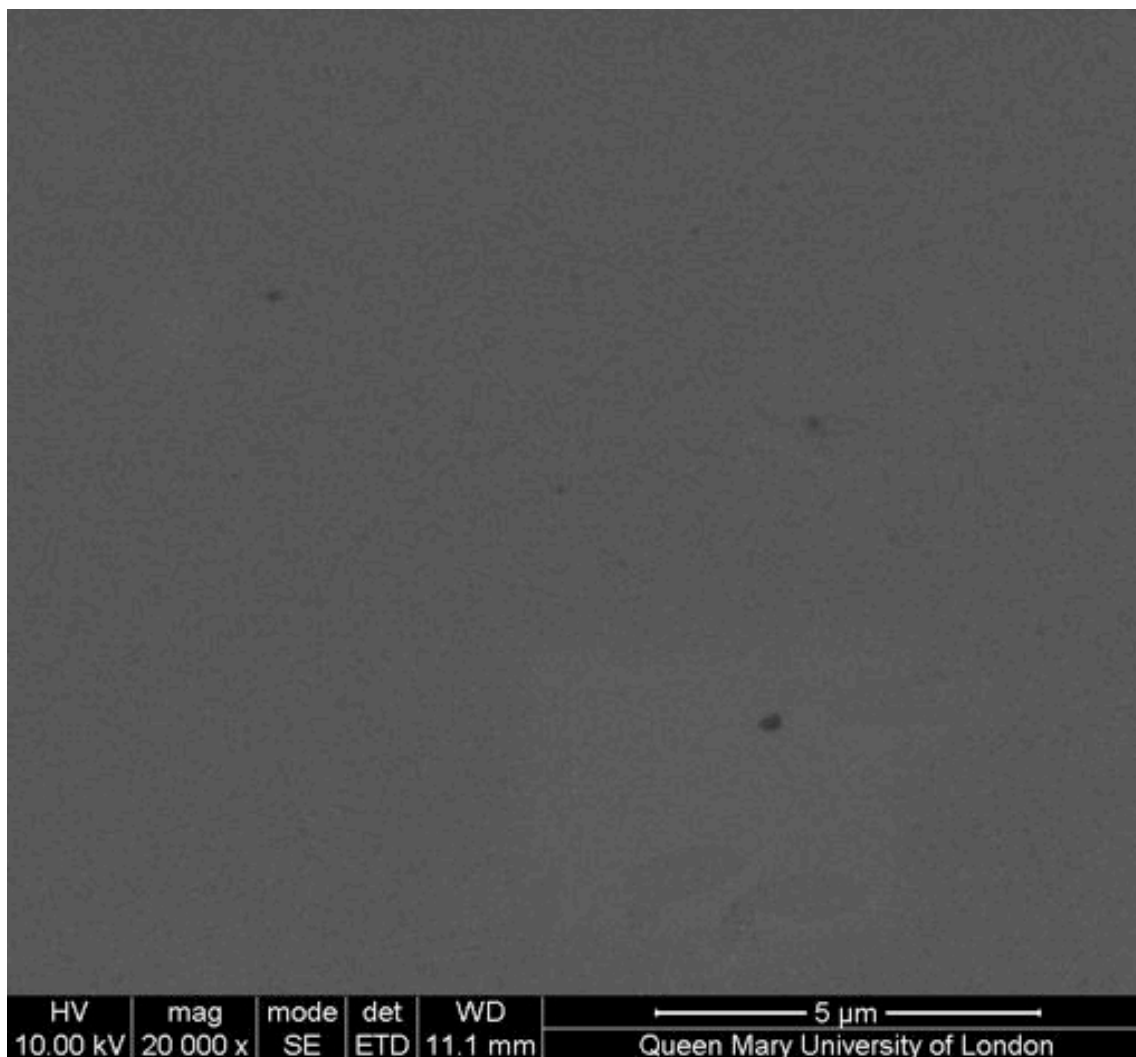
The stippled effect is probably a result from using the non-stick coated release film when bending and gluing the sample down.

this was also the reason for wicking of the glue across part of the sample.



# Middle of the sample

- As seen with x20,000 magnification.

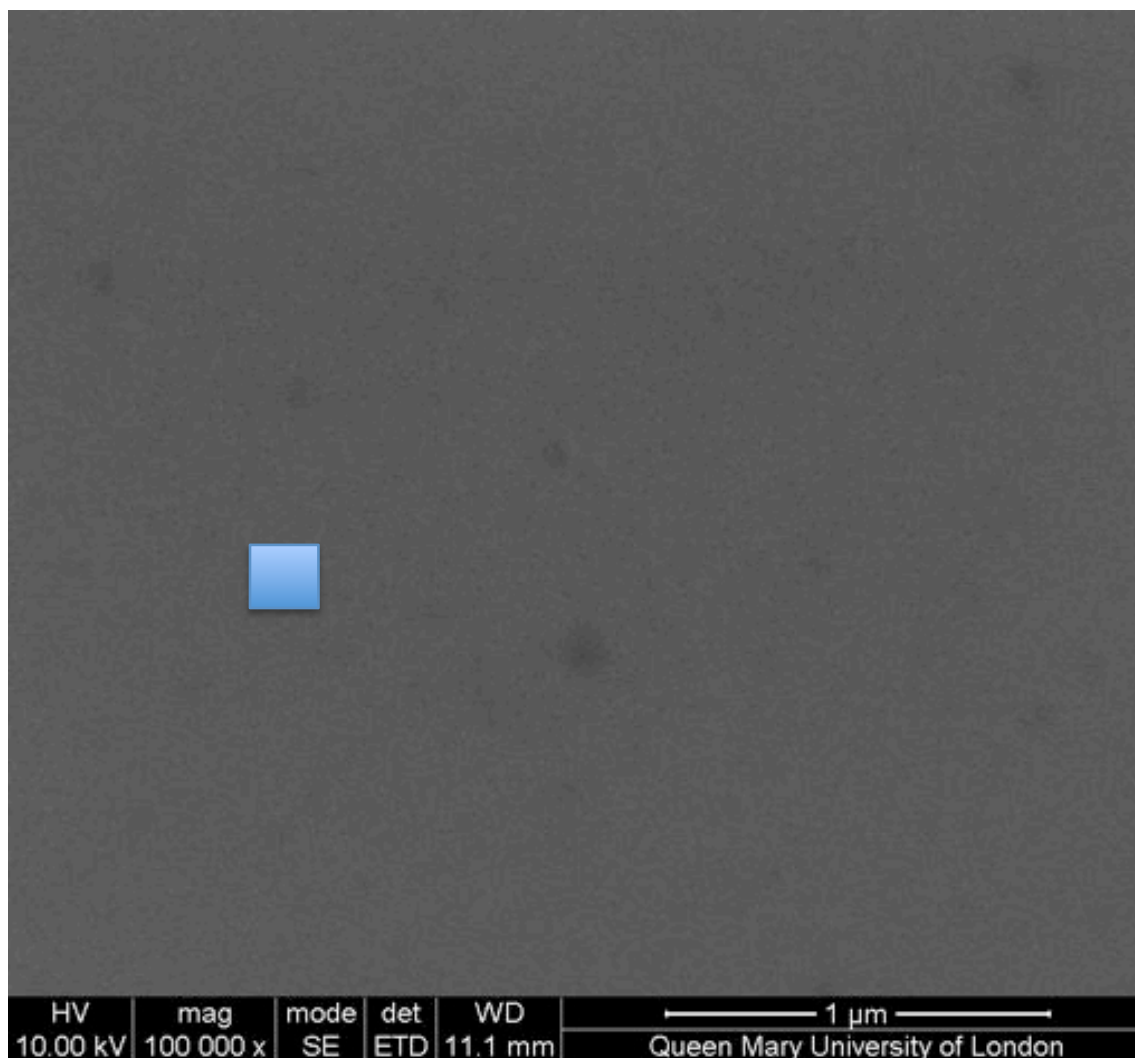


Mostly featureless surface  
(what we expected to see).



# Middle of the sample

- As seen with x100,000 magnification.



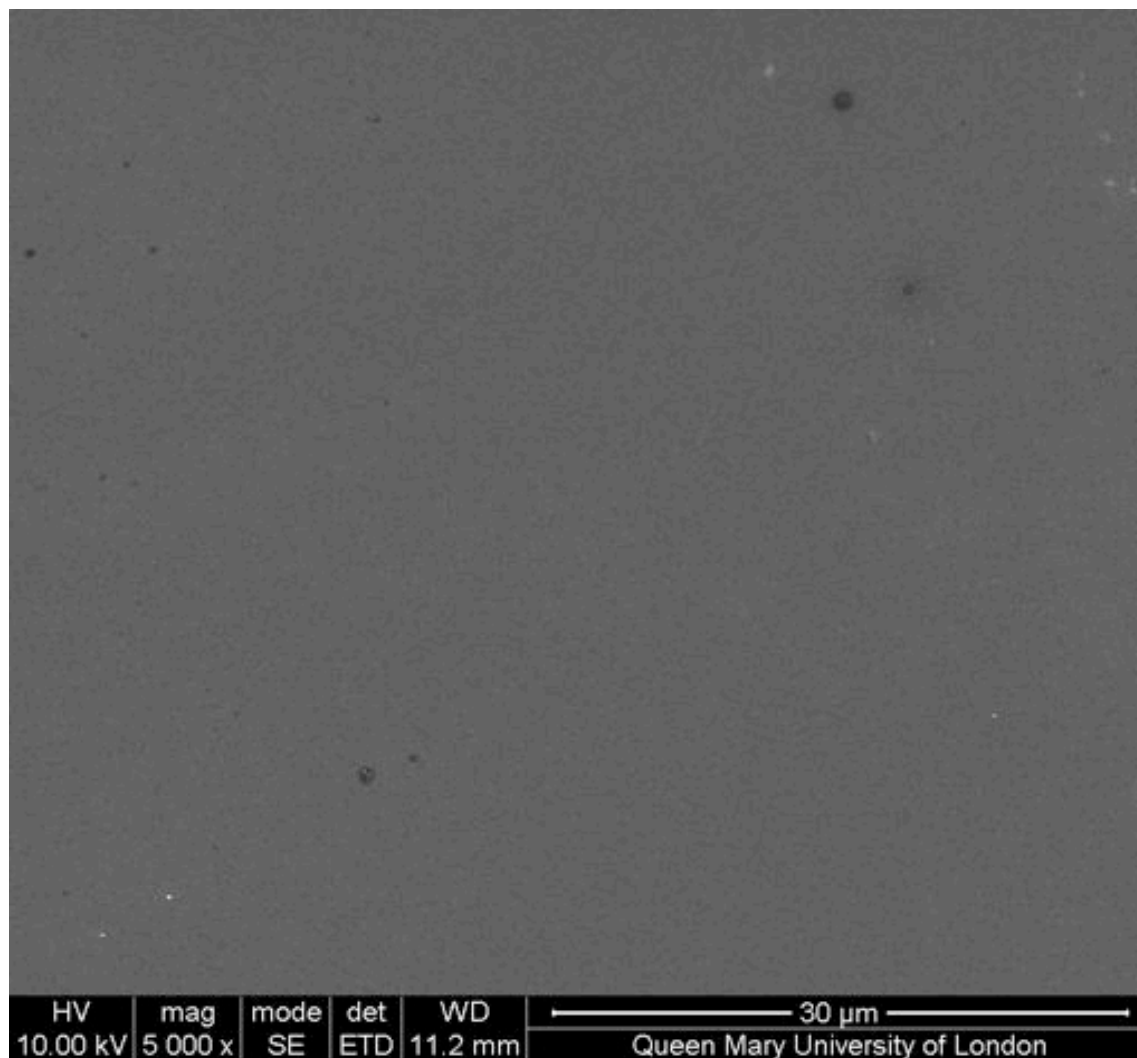
Mostly featureless surface  
(what we expected to see).





# Right side of the sample

- As seen with x5,000 magnification.

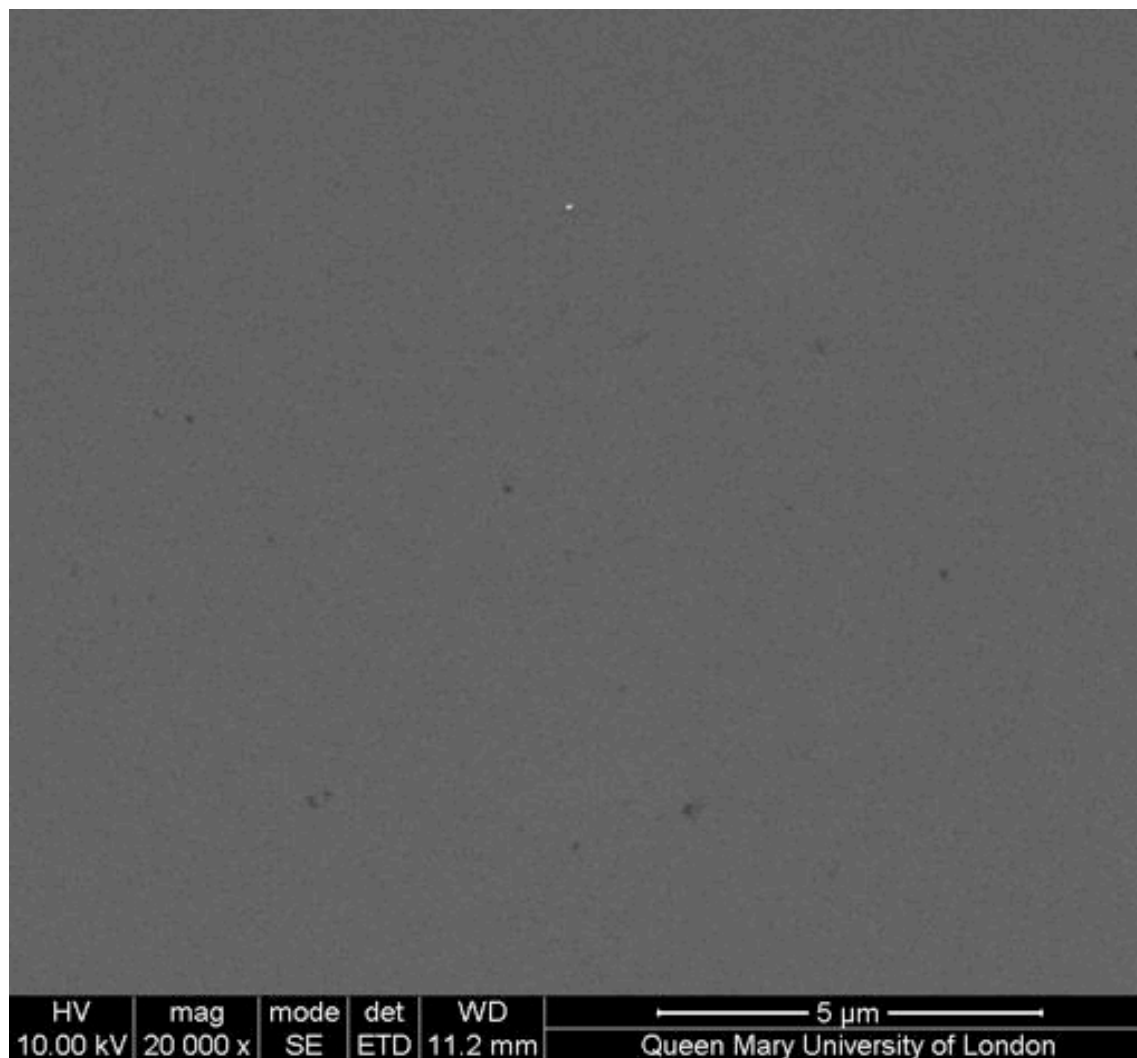


Mostly featureless surface  
(what we expected to see).



# Right side of the sample

- As seen with x20,000 magnification.

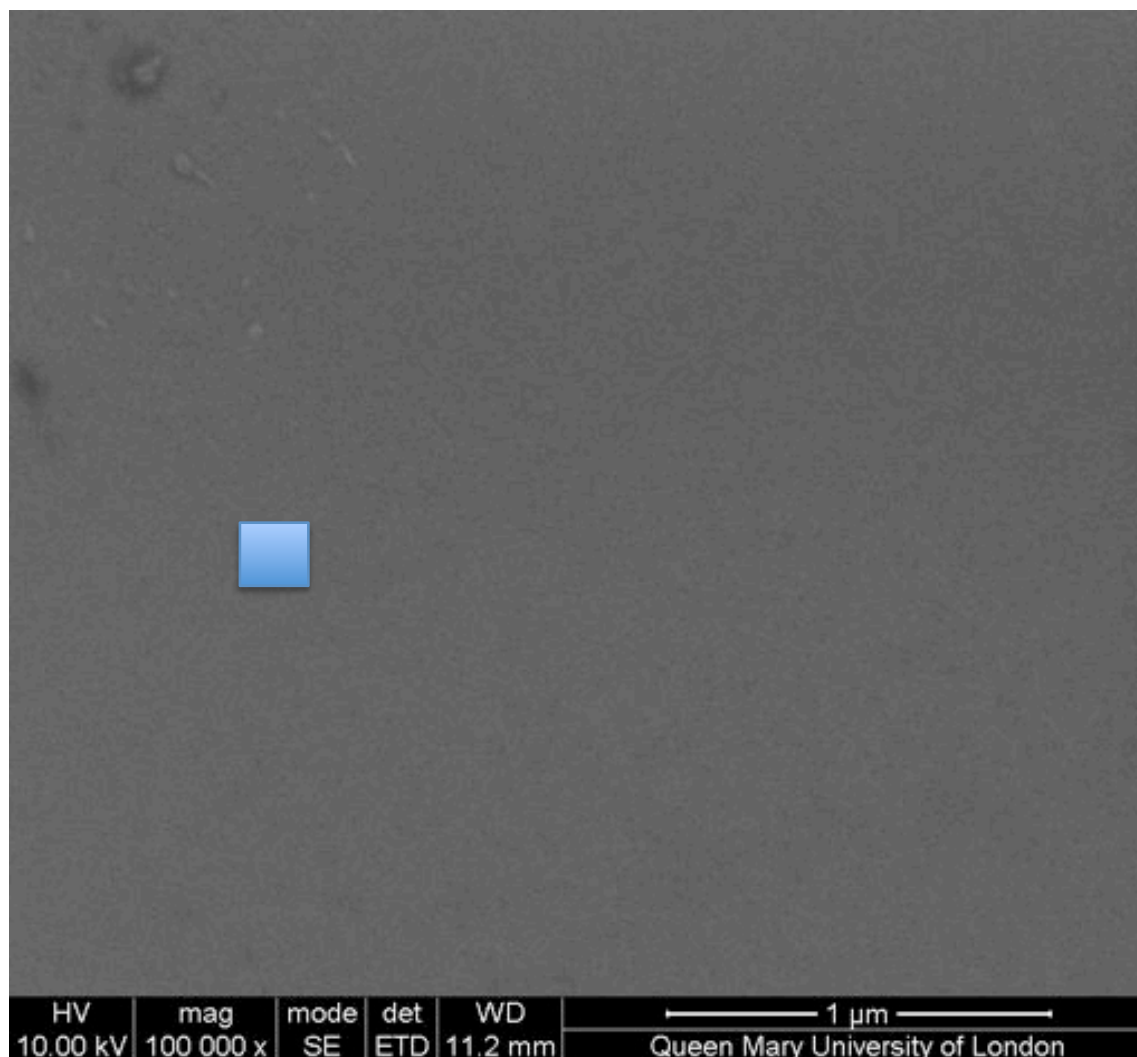


Mostly featureless surface  
(what we expected to see).



# Right side of the sample

- As seen with x100,000 magnification.



Mostly featureless surface  
(what we expected to see).



# Conclusion

- SEM images of this sample indicate that there is a problem with the sample near the edges.
- The large low density (dark) spots are comparable to the feature size of the sample.
- The other two sites that were looked at do not indicate the same pathologies on the surface – there are some lower density regions indicated, but these are few and far between.
- Suspect the non-uniformity that was seen with the "left side" of the sample is the result of this region being near the cut edge.
- The silicon surface a few mm from the edge looks to be much more uniform.



## (2) Bending coating silicon

- Plated a  $\sim 200\text{nm}$  thick coating of Al on Si die, uniformly over an area of approximately  $33 \times 25\text{mm}$ .
  - Painted 2 contact pads using Ag paint: one at each end.
  - Bent sample [measured resistance before and after].
  - No change in resistance:  $R = 10\Omega$ .

