Measurement of Spatial Resolution in VPPEM

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From theory we had found a good approximation of the edge resolution defined as the 20% to 80% change is $3\sqrt{E}/B$ microns with E in electron volts, and B in Tesla. This needed to be experimentally tested.

The energy of the electrons can be changed along the trajectories within the field by biasing the sample. This change of energy does not change the spatial resolution which is determined solely by the electron emission energy. The angle of deflection is inversely proportional to the square root of the energy of the electrons when they exit the field. However, the angles of the cyclotron orbits also change in the same way as the electrons are accelerated or decelerated. This means that in the VPPEM we can change the electron energy that we image from the sample without having to change the energy of the electrons exiting the vector potential field. This implies that the magnification of the system is the same for all energies, and comparing the spatial resolution at different emission energies is straightforward.

The figure shows the resolution measured across the cleaved Si wafer edge for different energies from 0.5eV to 50eV, and a field at the sample of 1 Tesla. A fixed photon energy of 80 eV was used. The energy resolution is 0.25eV, and the length scale was established using a 600 mesh Au grid. The plot is of the 20-80% edge resolution verses the square root of the electron energy at the sample in electron volts.

The slope of the plot is 2.93 very close to the theoretical estimate.

In conclusion a good approximation for edge resolution of the VPPEM is $3\sqrt{E}/B$ in microns with E in electron volts and B in Tesla.