1. Deposition rate measurements

A quartz crystal monitor (at a distance of 100mm from the source aperture) was used to measure the deposition rate of the clusters (note for Cu, 1Hz = 0.11Å).

The deposition rate was measured as a function of the magnetron power for various Ar flow rates and a set aggregation length of 205 mm.

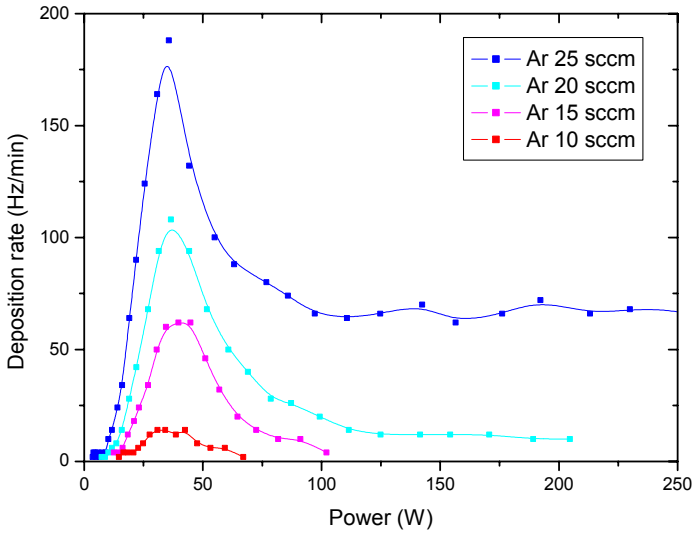

Figure 2: Deposition rate as a function of magnetron power for various flows

The deposition rate was measured as a function of the Ar gas flow rate for various aggregation lengths and a fixed power of 25Watts.

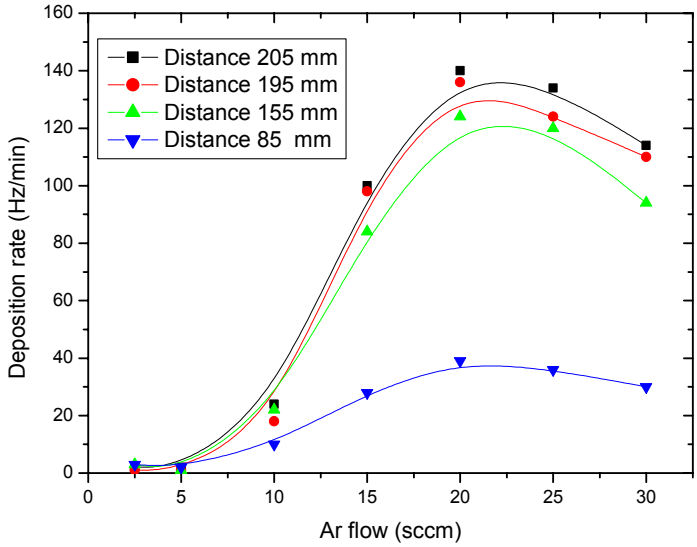

Figure 3: Deposition rate as a function of Ar gas flow rate for various aggregation lengths

Note that the deposition rate drops at higher Ar flow and magnetron power. This is due to the increased number of collisions between particles and thus a reduction in the mean free path of the clusters.

2. Cluster mass measurements

Cluster mass with Ar flow rate

The Ar flow rate was varied for a fixed power and aggregation length. The resulting mass spectra (taken using the QMF200) are shown below of negatively charged Cu clusters.

Power: 38W, Agg length: minimum, He: 0 sccm, Apertures 5mm inner, 4mm outer.

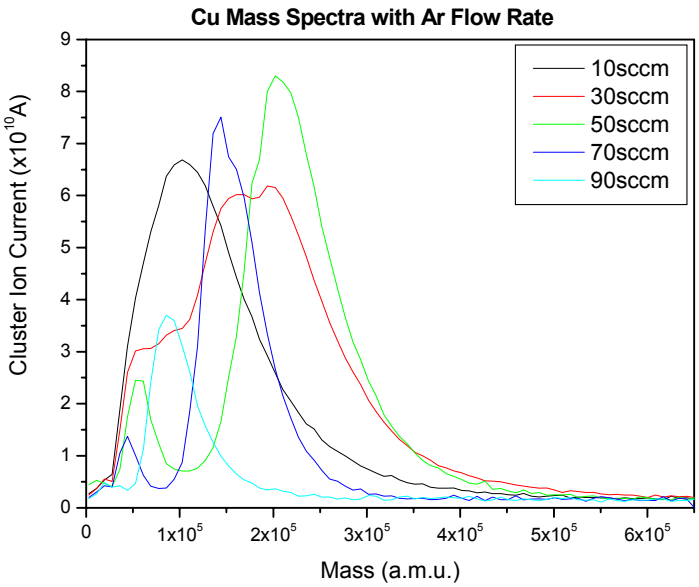

Figure 4.

From these spectra the mean cluster mass can be plotted as a function of the Ar flow. This is shown below in figure 2.

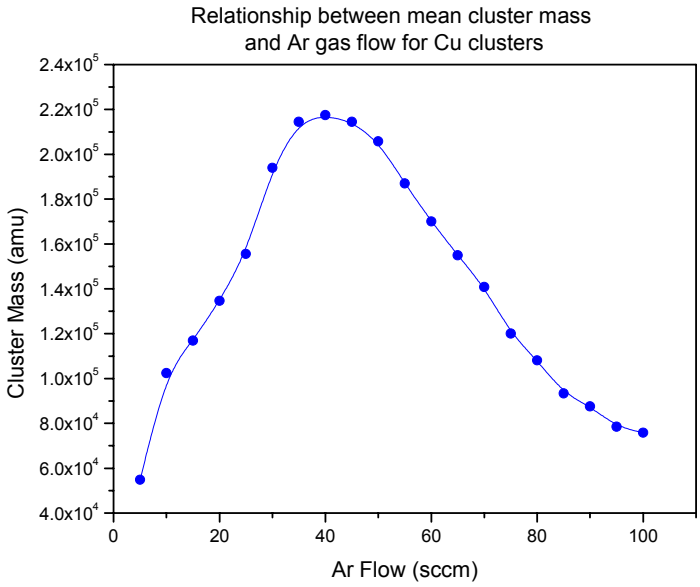

Figure 5

Cluster mass with He flow rate

The He flow rate was varied for a fixed power, aggregation length and Ar flow rate. The resulting mass spectra (taken using the QMF200) are shown below of negatively charged Cu clusters.

Power: 37W, Agg length: minimum, Ar: 20 sccm, Apertures 5mm inner, 4mm outer.

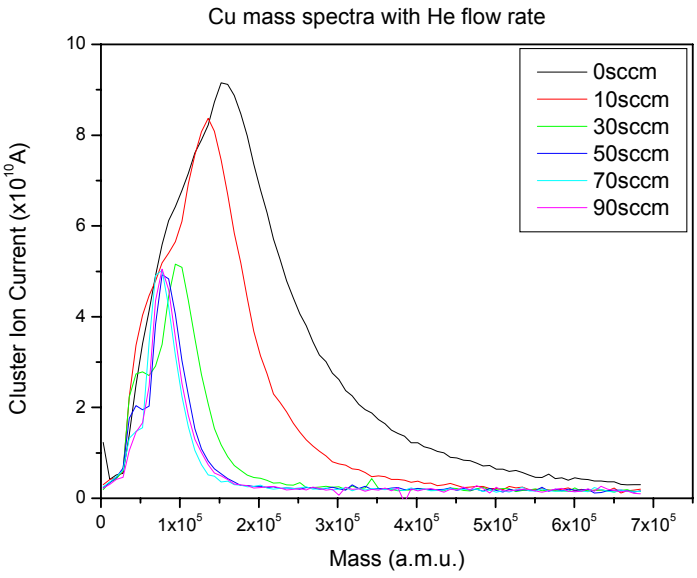

Figure 6

From these spectra the mean cluster mass can be plotted as a function of the He flow. This is shown below in figure 4.

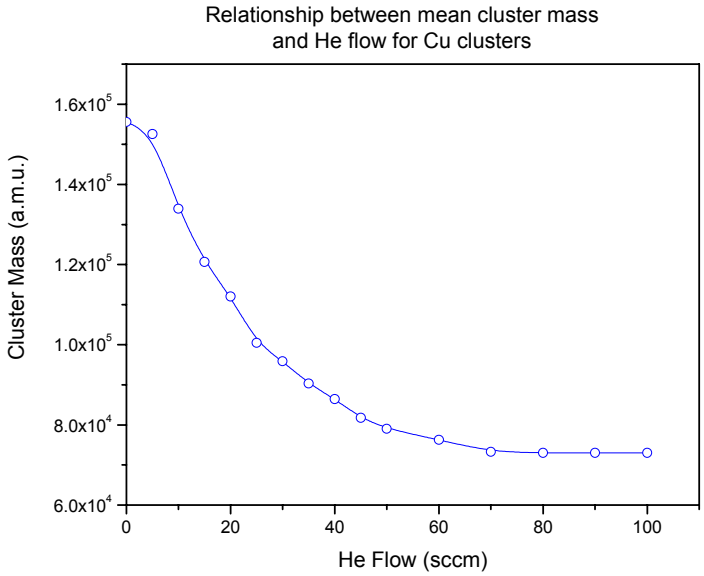

Figure 7

Cluster mass with magnetron power

The magnetron power was varied for a fixed aggregation length, Ar and He flow rates. The resulting mass spectra (taken using the QMF200) are shown below of negatively charged Cu clusters.

Agg length: minimum, Ar: 40 sccm, He: 60sccm, Apertures 5mm inner, 4mm outer.

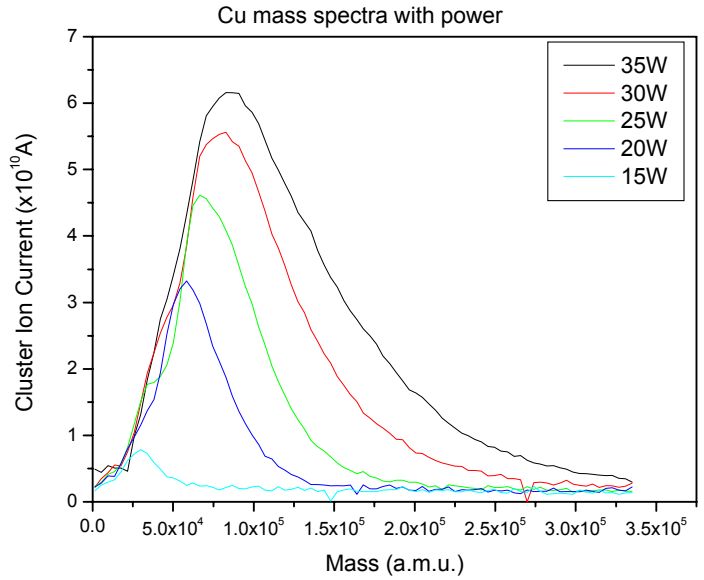

Figure 8

From these spectra the mean cluster mass can be plotted as a function of the power. This is shown below in figure 6.

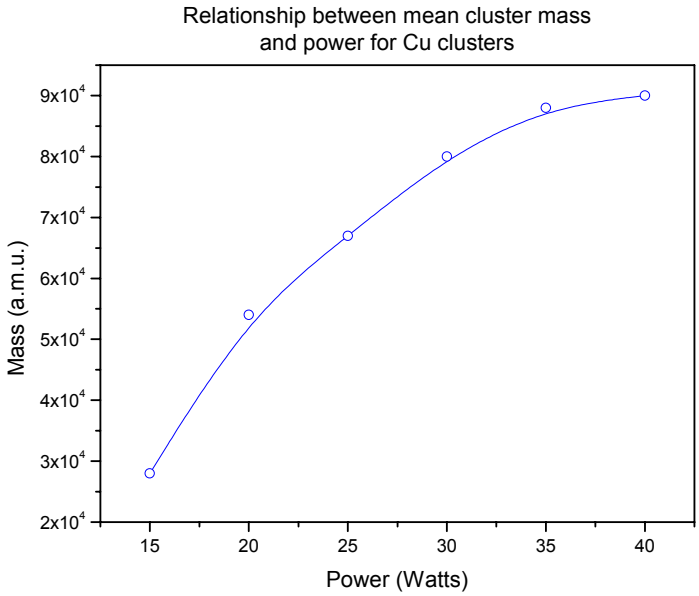

Figure 9

Cluster mass with aggregation length

The aggregation length was varied for a fixed power, Ar and He flow rates. The resulting mass spectra (taken using the QMF200) are shown below of negatively charged Cu clusters.

Power: 35W, Ar: 15 sccm, He: 0sccm, Apertures 5mm inner, 4mm outer.

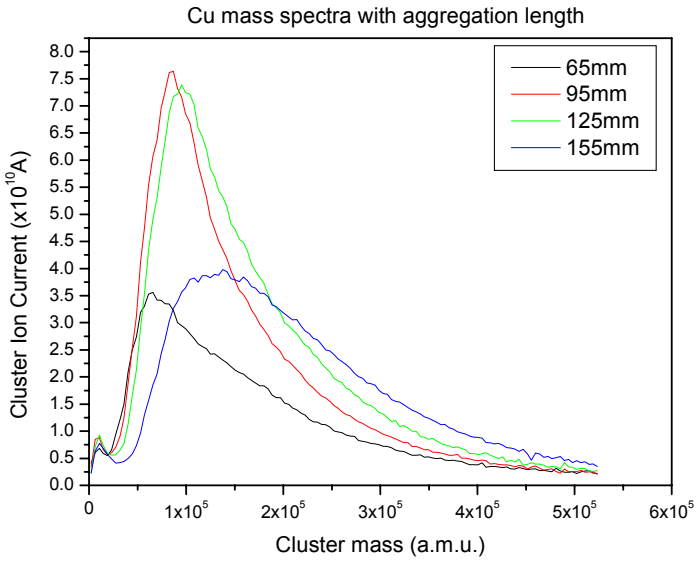

Figure 10

Large clusters

Large clusters can be acquired with the NC200U using high powers and relatively high Ar gas flows. The graph below shows such a spectrum which goes beyond the range of the QMF200. These clusters are positively charged.

Power : 95W, Ar flow: 65sccm, He:0, Aggregation length: maximum.

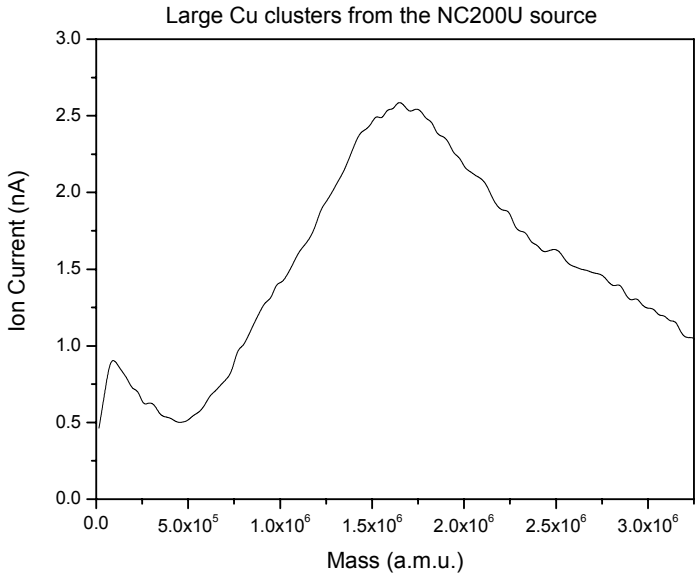

Figure 11

Small clusters

Small clusters can be acquired with the NC200U using low powers and high He gas flows. The graph below shows spectra of negatively charged clusters for two different He flows. Individual cluster peaks can just be resolved.

Power : 10W, Ar flow: 35sccm, He flow:110sccm, 90sccm Aggregation length: minimum

QMF: f=100kHz, U/V =0.15, Sit=0, External Keitherly nanometer input.

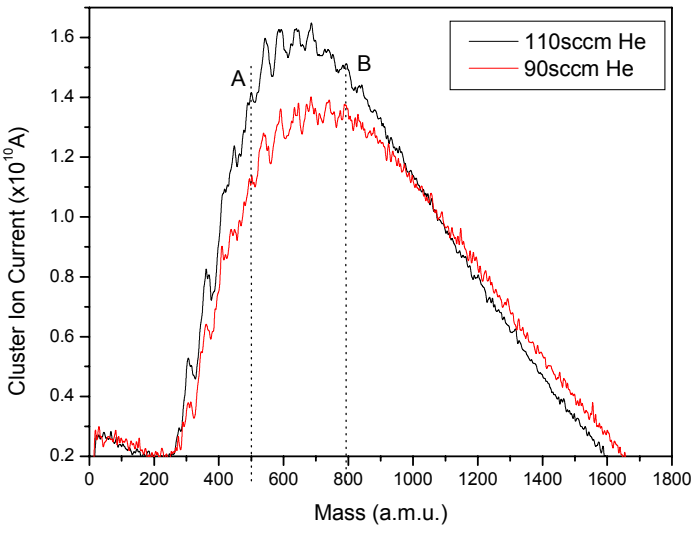

Figure 12

From the above graph the value of k (the correction factor) can be calculated. The value k is used in the calculation of the mass:

$$M=7x10^{7}(kV/f^{2}d^{2})$$

Where M is the mass, V is the AC voltage, f is the frequency and d is the diameter of the quadrupole poles.

On the graph the peaks A and B lie at 500amu and 793amu. There are five distinct peaks between these peaks giving an average separation of 48.8amu. For Cu clusters this value should be 63.5 (the atomic weight of Cu). The correction factor is therefore:

$$k= 63.5/48.8 = 1.30$$

This value is comparable with the result calculated by Baker et al[1]. (1.25) who determined the constant by using ionised Ar. The corrected mass spectrum is shown in figure 10. The number of atoms per cluster has been added.

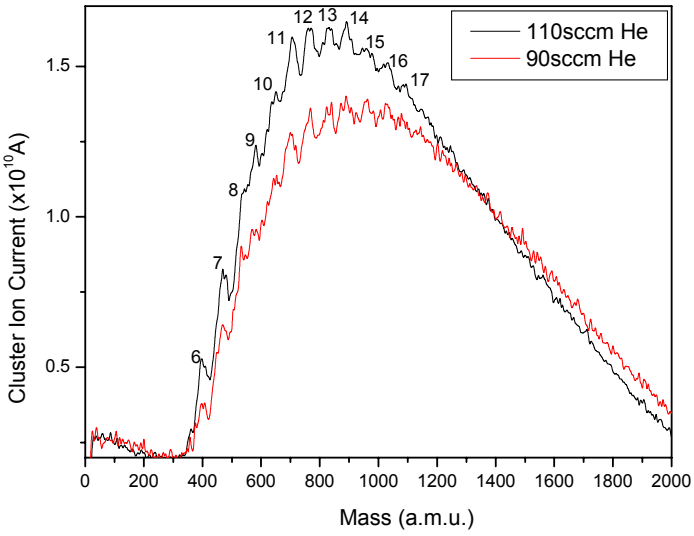

Figure 13

[1] S.H.Baker et al. Rev.Sci.Instrum. 68(4) p 1853, 1997.

3. Other measurements

Beam size from cluster source

The beam diameter was measured for different aperture plate arrangements at a distance of 100mm.

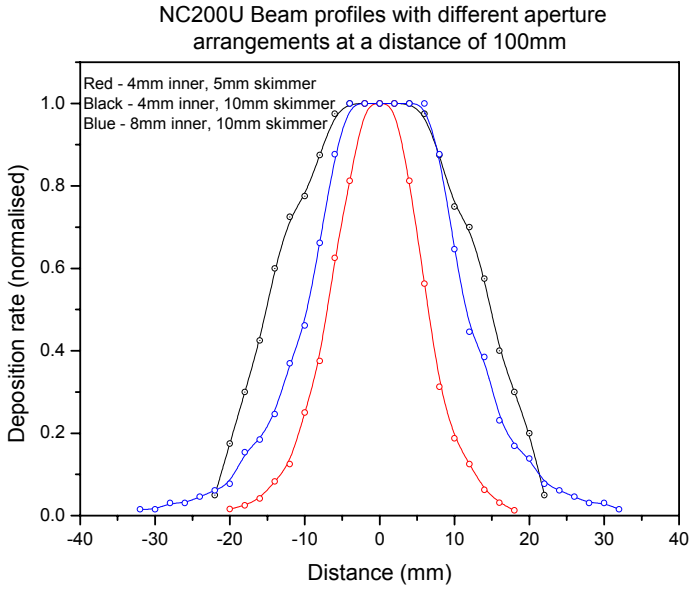

Figure 14