Simulation of removal processes for large surfaces

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Abstract

Homogeneous material removal is an important process step in ion beam based techniques like pattern transfer, smoothing or planarization. The sample dimensions are often larger than the beam size of the ion source. To process large samples various motion strategies like meander or spiral paths are commonly used. Therefore, the design of the vacuum chambers scales directly with the sample size.

To overcome this drawback, new approaches for the realization of a homogeneous removal were developed at the IOM. Two algorithms are presented. Both ideas rely on broad beam ion sources with a large full width at half maximum and were validated for Ar as processing gas.

The first is a multi-radii algorithm. The sample rotates relatively to the ion source and the centres of the sample and ion source are shifted relatively to each other. The number of displacement steps is not limited. Figure 1 shows the working principle. Using this approach, a homogeneous removal in the range of 2 % was achieved at a sample radius of 225 mm with two displacement steps.

In a second approach the shape of the removal profile near the inflection point $P_I(x_I,y_I)$ is used to achieve a homogeneous removal. The ion source is moved in two scans along the x axis - one at + y_I position and the other at - y_I position. The overlay of the two profiles results in a homogeneous removal.

Both motion strategies allow new compact plant designs and are well suited to achieve precise etching results on large scale workpieces.

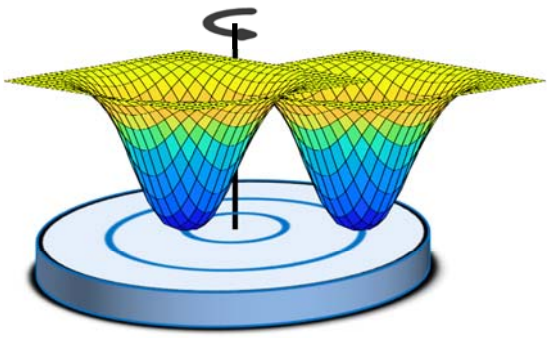

Figure 1: The example of two displacement steps illustrates the basic principle.