

Focused Ion Beam Technique Description

Focused Ion Beam (FIB) is an analytical method used to provide site specific material removal and deposition on the nanoscale. The removal can be with lateral resolution less than 10 nm and deposition resolution can be less than 100 nm.

FIB instruments typically use gallium liquid metal ion sources to sputter the sample surface. The sputtering process results in atoms or molecules removed from the surface. Sputtering at an edge is typically faster by about a factor of three or more than sputtering on a flat surface.

The deposition is made possible by use of a metal organic gas source. The gas is absorbed on the surface and decomposed with the ion beam. The method can be described as ion beam assisted chemical vapor deposition.

The interaction of the gallium beam with crystalline materials, particularly metals, provides different secondary electron yields for grains with atoms aligned with the incident beam compared with grains where the atoms are not aligned. As a result it is possible to image a metal surface and observe grain boundaries.

The FIB is often paired with a Scanning Electron Microscope (SEM). With this combination, it is possible to sequentially cut and image to provide a three dimensional analysis. Imaging with the electron beam of the SEM also prevents damage of the sample surface that occurs when one images with the gallium beam.

The site specific material removal and deposition capabilities have led to many FIB applications. Materials analyzed cover a very wide range and include polymers, metals, glass, semiconductors, and biological specimens. Besides imaging with the ion beam, the FIB is often used to prepare specimens for SEM and transmission electron Microscopy (TEM). Modification of semiconductor devices and patterning of samples can also be achieved. The ion beam can use the information in a bit-map to etch complicated features.