Scanning Electron Microscopy

The first Scanning Electron Microscope was debuted in 1942 and commercially produced in 1965.SEM is popular because of its versatility, various modes of imaging, ease of sample preparation, possibility of spectroscopy and diffraction as well as easy interpretation of the images. The best image resolutions is in the range of 0.5 nm , SEM images have a characteristic three dimensional appearance and can be used to judge structure,

In SEM, a monochromatic electron beam with a very fine spot size of ~ 5nm and having energy from a few hundred eV to 50 KeV is passed over the surface of the specimen which induces various changes in the sample. The resulting particles from the sample are used to create an image of the specimen. The information is derived from the surface of the sample. The schematic of SEM is shown in the figure. SEM consists of an electron gun at the top, the "Virtual source" that produces a stream of monochromatic electrons. The stream is then condensed by the first condenser lens (usually controlled by the "coarse probe current knob"). This lens is used to form beam and also to limit the amount of current in the beam. The condenser aperture along with the first condenser lens works to eliminate the high-angle electrons from the beam. The second condenser lens forms electrons into a thin, tight, coherent beam and is usually controlled by the "fine probe current knob". The objective aperture further eliminates high-angle electrons from the beam. A set of coils "scan " or sweep the beam in a grid like fashion, dwelling on points for a period of time determined by the scan speed. The last objective lens, focuses the scanning beam onto the part of the specimen desired. The beam of electrons strikes the sample and interactions occur inside the sample and are detected by various instruments. The instruments count the number of interactions and display a pixel on a CRT whose intensity is determined by this number of

interactions. Then beam moves to the next dwell point. This process is repeated until grid scan is finished and then repeated, the entire pattern cab be scanned 30 times per second.

In SEM, high spatial resolution microanalysis of materials is possible. The spatial resolution of the analysis is made possible by the small dimensions of excitation beam, of the order of a few nanometers. The electron beam causes various excitations in the sample that are the characteristic of the elements present in the material.