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Scanning Electron Microscope

KMÜ 396
Material Science and Technology
Scanning Electron Microscope (SEM)

Figure 1 - Scanning Electron Microscope
History

- First microscope is made in 1590 by Hans Lippershey and Hans Jansen in Netherlands.
- SEM is discovered by Max Knoll in 1953.
- The SEM was first marketed in 1965 by The Cambridge Scientific Instrument Company.
Why Do We Use SEM?

- To generate high resolution images of shapes of objects and show spatial variations in chemical compositions:
  - Elemental maps
  - Discrimination of phases based on mean atomic number
  - Compositional maps based on differences in trace elements
**What Is The Sem`s Parts And How Is It Working?**

Essential components of all SEMs include the following:

- **Electron Source ("Gun")**
- **Anode**
- **Magnetic Lens**
- **Scanning Coils**
- **Backscattered Electron Detector**
- **Secondary Electron Detector**
- **Stage**
- **Tv Scanner**
Figure 2 - Parts of the scanning electron microscope
Electron gun provides electron beam for the system.

Magnetic lens uses for focusing and deflection of electrons.
**Scanning coils** Scan the electron beam which is going between positive and negative charge.

**Backscattering electron detector** produce a pure compositional signal.

**Secondary electron detector** converts light pulse to electron pulse. The signals are converted with **Tv scanner** which can be readable by people.

![Scanning coil model](image1)

*Figure 5 - Scanning coil model*

![MCP (Microchannel Plate) Detectors For SEM and CD-SEM](image2)

*Figure 6 - MCP (Microchannel Plate) Detectors For SEM and CD-SEM*
The SEM is the best microscope to study on the solid materials.

Mostly used in geologic applications.

The electron which produce from electron gun, has a kinetic energy.

This energy produce a special signals by electron sample interactions when the electrons are decelerated in the solid sample.
These signals include some electrons, photons, visible lights and heat.

Backscattering electrons and secondary electrons commonly use for imaging samples.

Secondary electrons are most valuable for showing morphology topography.

Backscattering electrons illustrate contrasts incomposition in multiphase samples.

These data carry on the TV scanner.
Figure 7 - Image Of Metal Foam In Scanning Electron Microscope
Figure 8 - Regular Home Fly
Advantages

✓ SEM’s are easy to operate.
✓ It is easy to set simple preparation.
✓ We could get the result in 5 minutes digitally.
✓ We could search every solid materials.
✓ We can deeply search the surface of the sample.
✓ The images have very good resolution.
Disadvantages

- Samples must be solid and they must fit into the microscope chamber.
- SEM’s cannot detect very light elements such as H, He, Li and the atoms which have atomic number less than 11.
- SEM is very expensive microscope.
References

- http://www.twi.co.uk/content/eb_physics.html
- http://bama.ua.edu/~surfspec/sed.htm
- http://www4.nau.edu/microanalysis/microprobe/Column-Stigmators.html
- http://www.atclabs.com/SEM.htm
- http://www.freudlabs.com/electron-optical_consumables
Thanks For Listening...

That's all Folks!