



HACETTEPE ÜNİVERSİTESİ
Kimya Mühendisliği Bölümü

Scanning Electron Microscope



Mustafa Can AYGAN / #20722626

*KMÜ 396
Material Science and Technology*



Scanning Electron Microscope (SEM)



Figure1 - *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 element*

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*

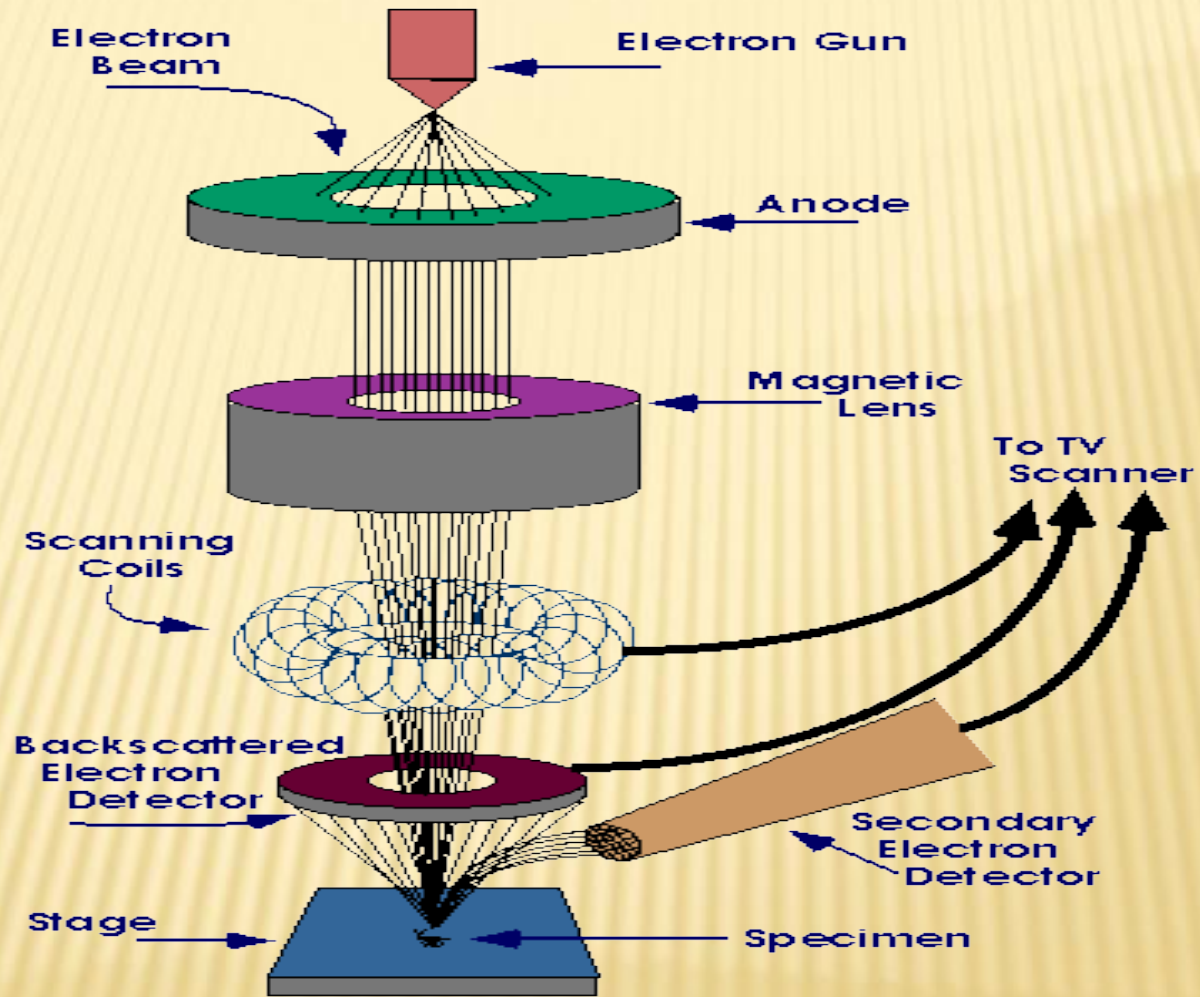


Figure 2 - *Parts of the scanning electron microscope*

Electron gun provides electron beam for the system.



Figure 3 - *Basic electron gun*

Magnetic lens uses for focusing and deflection of electrons.



Figure 4 - *Magnetic lens on camera*

Scanning coils Scan the electron beam which is going between positive and negative charge.

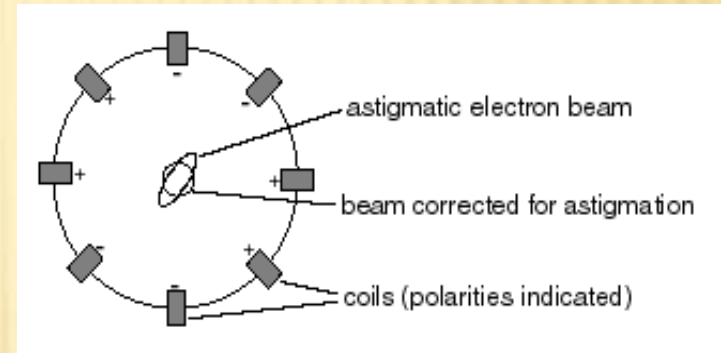


Figure 5 - *Scanning coil model*

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.

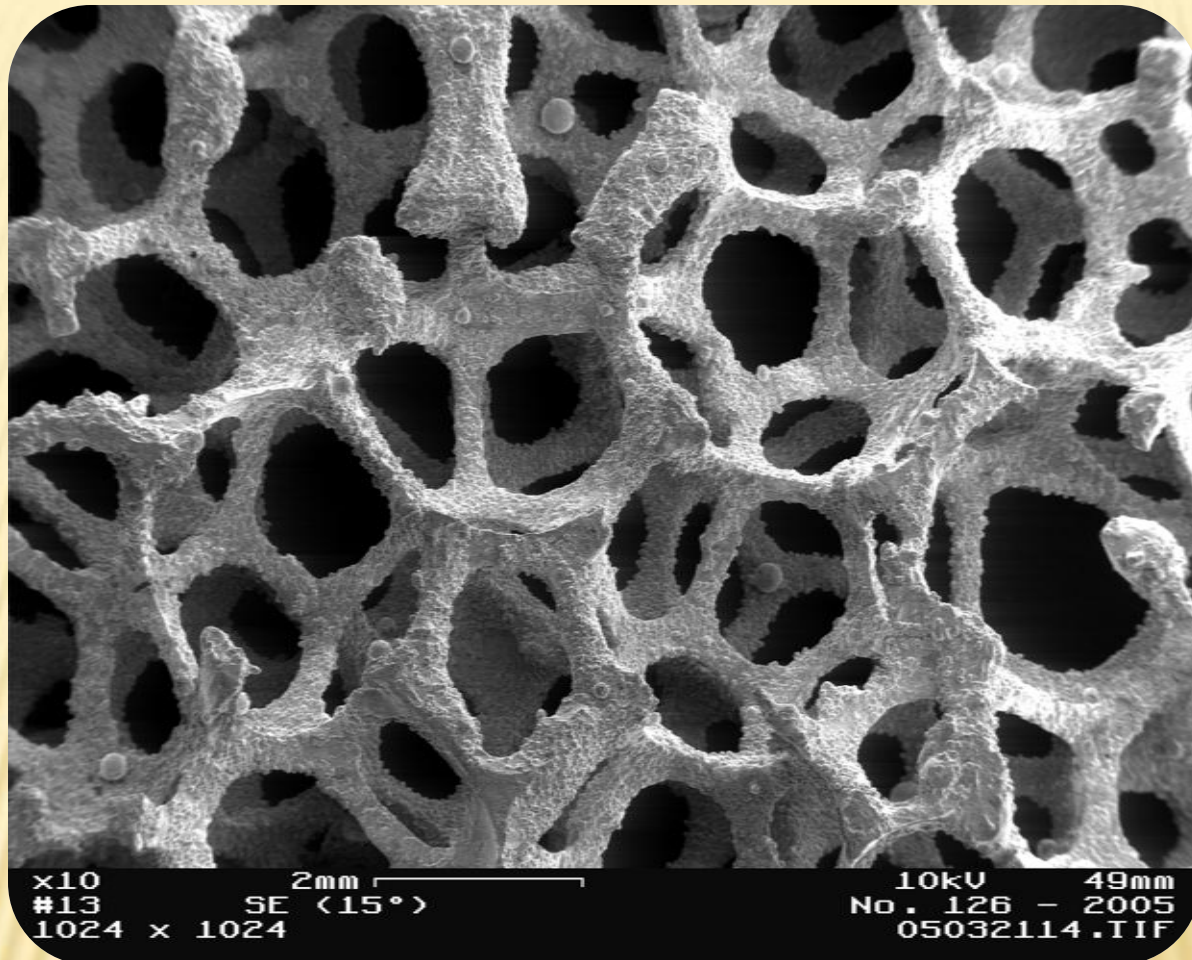


Figure 6 - *MCP (Microchannel Plate) Detectors For SEM and CD-SEM*

How Does The System Work?

- ✓ The SEM is the best microscope to study on the *solid materials*.
- ✓ Mostly use in *geological* 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.

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- ❖ 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 in composition in multiphase samples.
 - ❖ These data carry on the *TV scanner*.



*Figure 7 - Image Of Metal Foam
In Scanning Electron Microscope*

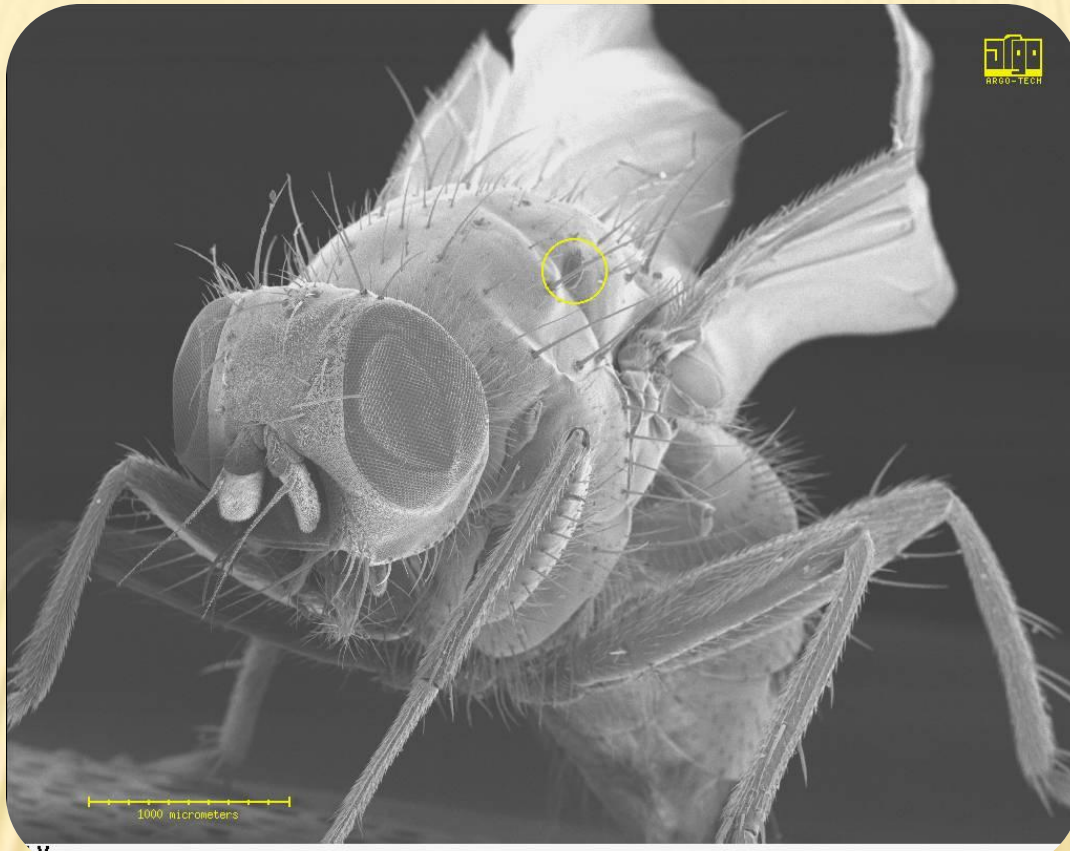


Figure 8 - *Regular Home Fly*

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

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Thanks For Listening...



That's all Folks!