

Electron microscope

lec4

An **electron microscope (EM)** is a type of microscope that uses **an electron beam** to illuminate a specimen and produce a magnified image.

It has a greater resolving power than a light microscope and can detect the structure of smaller objects. They can achieve better than **50 picometer** resolution and magnifications of up to about **10,000,000x** whereas ordinary light microscopes are limited to about **200 nm** resolution and magnifications below **2000x**.

The electron microscope **uses electron optical lenses** to control the electron beam and focuses it. The role of electron optical lenses is similar to the glass lenses of a light optical microscope.

Electron microscopes are used to investigate the structure of a wide range of **biological and inorganic specimens including microorganisms, large molecules, biopsy samples, metals, and crystals.**

The main component of electron microscope

1. Electron gun (cathode): a heated filament or crystal, made from the metal tungsten that releases electrons when a high voltage is pass through.

2. Electromagnetic lens: is a coil of wire through which current flows, **creating magnetic fields** that manipulate the electron beam, much the same way that optical lenses focus and direct light.

3. Anode: to accelerate the electron beam.

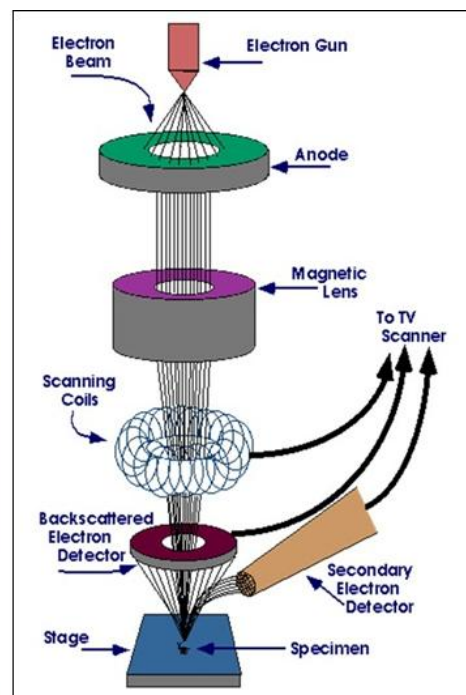
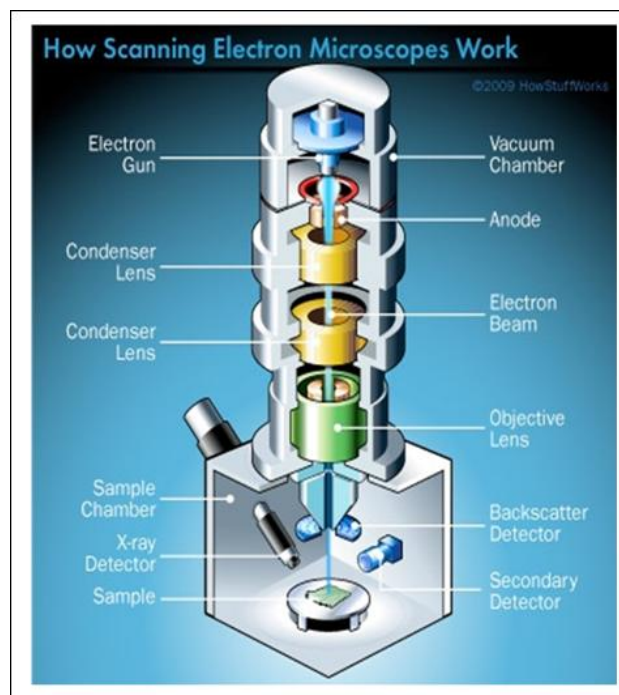
4. Vacuum system to ensure that the microscope is operated under a high vacuum **to maintain the integrity of the electron beam.**

5. Camera or detector

6. Computer

Principle

1. The beam is produced by the electron gun at the top of the instrument.
2. The electron beam then passes down through the vacuum system.
3. Because electrons change their path when pass in electromagnetic field (electromagnetic lens) the beam can be focused.
4. First lens is a condenser which focuses the beam of electron on the specimen.
5. Some electrons interact with the specimen and are modified while other crosses the specimen without interacting.
6. Electron passing through the specimen reaches the objective lens, which form a focused magnified images that is then magnified further through other lenses and captured on screen.



Types

1. Transmission electron microscope is a microscopy technique in which a beam of electrons is transmitted through an **ultra-thin specimen** that permits high resolution, this high resolution allows magnification of **up to 400,000** times with isolated molecules or particles

2. Scanning electron microscope is a microscopy technique that permits a **three dimensional image** of the surfaces of cells, tissues, and organs. Like the transmission electron microscope, this microscope produces and focuses a very narrow beam of electrons, **but in this type the beam does not pass the specimen**. Instead, the surface of the **specimen is first dried and coated with a very thin layer of metal** which electrons interact with and produce reflected electrons. These are captured by the detector and result in a **black and white image on monitor**.

