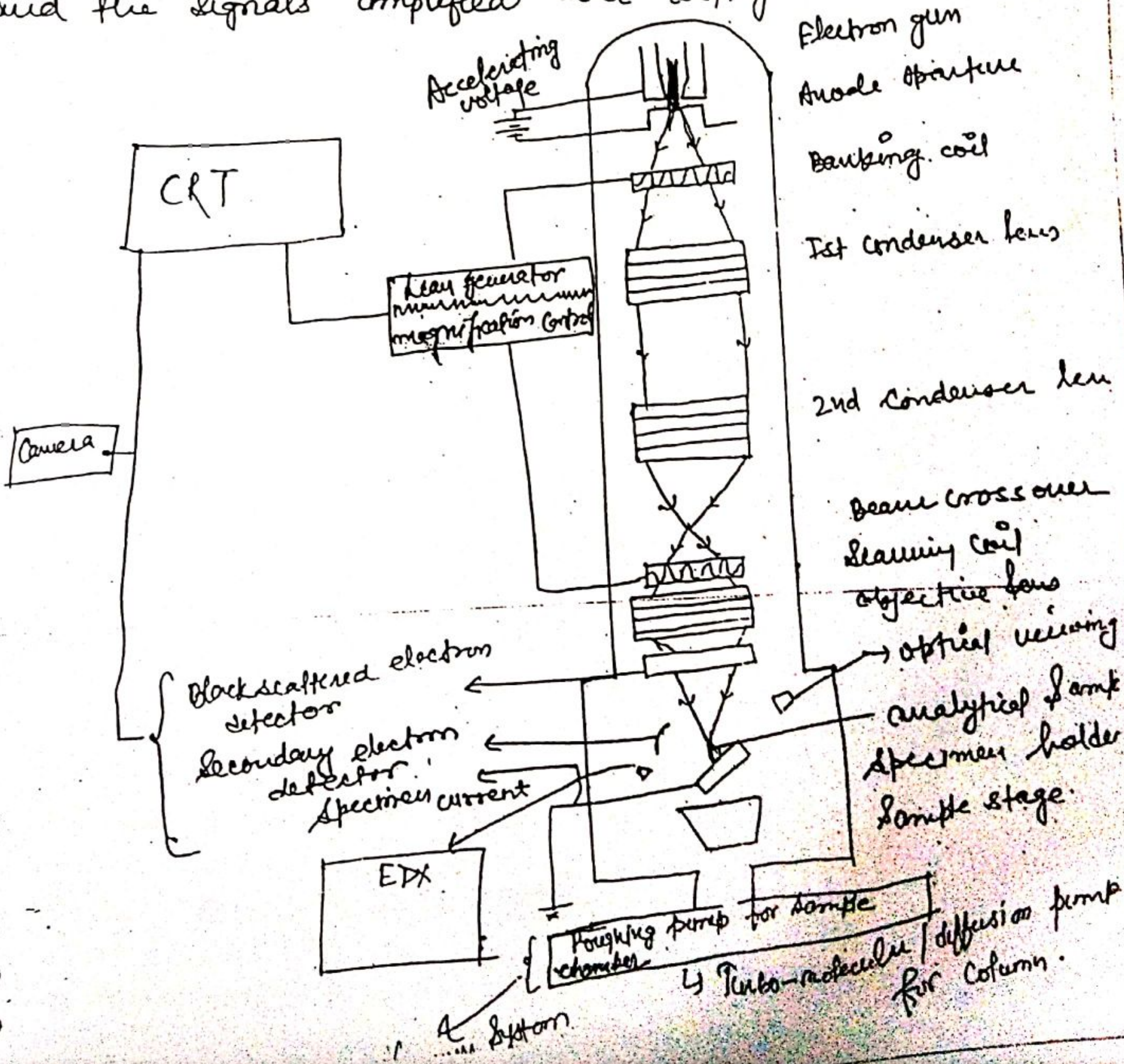
Scanning Electron microscopy [SEM] and Electron Probe Microana

The main component of the SEM are shown in the figure. the electron gun at the top of the electron "optical Coloum Produces the electron beam. the beam is focused to a diameter of ~50Å at the foot of the Coloum by a series of the magnetic lenes and is scanned in a square T.V. type raster across the surface of the specimen. the various 2° effects emitted from the surface of the specimen (e.g second electrons, backscattered electrons, X-rays) may be detected and the signals amplified and displayed.



Components :- Generally, two types of materials are used to produce electrons. Filaments made of either tungsten (W) or lanthanum hexaboride (LaB_6). The cathode is heated directly by a filament current i_f. Electrons exit the filament with average energy:

$$\boxed{E_e \sim KT}$$

The energy ~~nece~~ necessary to facilitate the ejection of an electron from a material surface is governed by the work function of that material. The energy required to emit electrons is derived from the heat produced by the filament current.

Richardson's Law (Richardson-Dushman equation) relates the current density J_c obtained by thermionic emission of the filament:

$$\boxed{J_c = A_c T^2 \exp\left(\frac{-\phi_W}{K_B T}\right)}$$

where A_c = is a constant that is characteristic of material

T = Absolute temperature.

ϕ_W = work function of the material

K_B = Boltzmann constant.

Use of the material with a lower work function ϕ_W or a higher constant A_c result in the increase in the cathode current density.

. The electrons are emitted as a point source called a space charge that is centered along the horizontal optical axis of the microscope. A positively charged anodic plates serves to accelerate electrons through the aperture.

roscopes are equipped with condenser and objective
s; . the electron beam exiting the anode plate
he electron gun assembly is divergent. A condenser
is responsible for collimating the divergent

ii
Secondary electrons are collected and examined by scintillator. Photomultiplier "Even-hart-thornley detector"
e secondary electrons are first collimated by a
d with an applied bias and then impacted upon
e detector surface.

High points and surface features that face the
ctor produce more 2° electrons and hence a
ter signals. Backscattered electrons (BSEs) are
cted by a semiconductor array located at the
tem of the coloumn. A current is produced when
≥s strike the semiconductor array.

age Generation :- image generation occurs by
stering the electron beam across the sample surface.
~~records~~ reconstructed image of is formed and
t to CRT and viewed. During the rastering process
e is a "dwell time" at which point the beam is
used. During the "Dwell time" the numerous types
secondary electron effect are expressed. the life time
secondary effects is shorter than that of the dwell
ime. Before the beam moves to the next segments
secondary effects have been detected, recorded and

Magnification, brightness and contrast all affect the image quality. Cathodoluminescence is an imaging technique used mostly in investigating luminescence from mineral specimens. A camera housed in the column system takes a photograph for emitted light from the same.

Operation:- Sample loading and mounting begin by fixing the specimen to a metallic stub with graphite cement or conducting tape. The stub is then attached to the metallic stage and placed inside the sample chamber. The chamber is evacuated with a roughing pump. The column is evacuated to a pressure less than 10^{-6} torr in order to begin the filament warm up process. The acceleration potential is stepped up slowly once the beam current is detected and adjusted, the sample is introduced in to the column and is ready for analysis.

Accelerating voltage ranges from 0.5KV to 30KV. New lens systems are able to correct spherical and chromatic aberration, thereby improving the resolution of objects. This.