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1. Tensile strength experiment by UTM

1.1 Introduction

The word "universal" typically refers to something that is adaptable enough to be employed in all applications. It implies that the machines can be simply altered to meet the specific testing needs and project requirements. Because of their adaptability, universal testing machines enable users to choose the maximum force, the testing area, and the kind of accessories required for a given test. Any application can be adapted for these testing devices. The Universal Testing Machine can adapt as testing requirements change. The materials used here are aluminum, polycarbonate and CFRP.

Figure 1-1 UTM

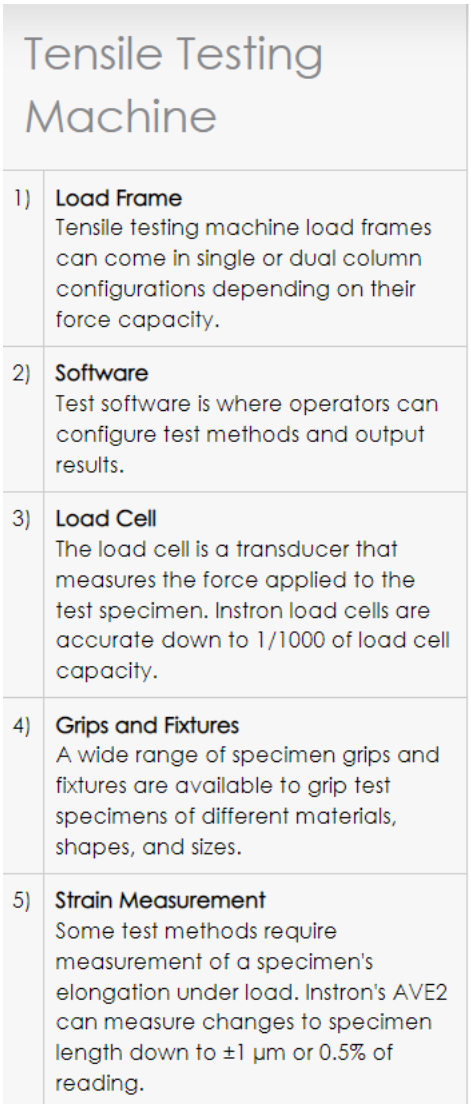

Figure 1-2 Components of UTM

Pump, oil in oil sump, load dial indication, and central buttons are all hydraulically operated. Upper, middle, and lower cross heads, or specimen grips, are on the left (or jaws). Adjustment is possible by raising and lowering the idle cross head. The pumped oil under pressure flows on the left parts of the lift and right parts through the pipelines connecting the lift and right parts to further the cross-heads.

1.2 Hydrogen Cathodic Charging of samples

Studies on how hydrogen affects the technical characteristics of metallic alloys, polycarbonates and CFRP have recently been conducted as a result of hydrogen's rising significance among alternative energy sources. Because of its light weight, fabricability, physical characteristics, corrosion resistance, and affordability, cast and wrought aluminum are among the most widely used metallic materials. But scientists still don't fully comprehend how hydrogen interacts with aluminum. In this experiment, aluminum used in significant technical and industrial applications had its surface layers charged with hydrogen using a cathodic hydrogen charging process. Study was done on how aluminum's structure, surface microhardness, and mechanical behavior were affected by hydrogen absorption. Furthermore, it was discovered that charging circumstances had a significant impact on the absorption of hydrogen. After prolonged charging circumstances, aluminum that had been hydrogen charged

showed signs of having aluminum hydride in its surface layers. Aluminum surface layer hardening brought on by hydrogen absorption and, occasionally, hydride production was also noted. The ductility of aluminum decreased with increasing hydrogen charge time, for a constant value of charging time, and with increasing charging current density, for a constant value of charging time, according to tensile experiments. The hydrogen charging process did, however, marginally reduce their final tensile strength. The top layers of the catholically charged aluminum showed brittle transannular fracture, whereas the deeper layers of the alloy showed ductile intergranular fracture.

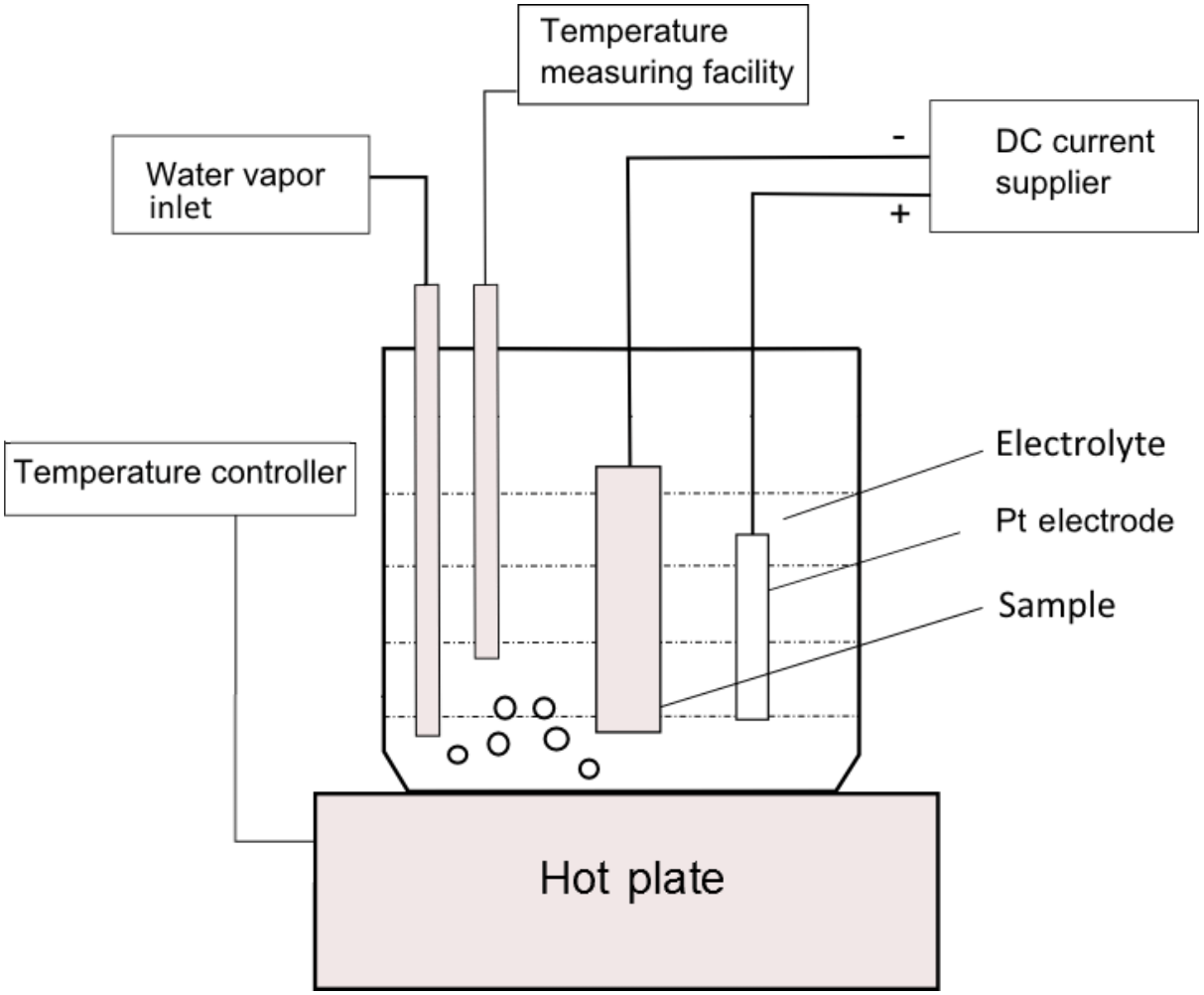

Figure 1-3 Working of the Hydrogen Cathodic Charging

In this article, carbon fibers (CFs) were treated using a novel electrochemical technique called alternating anode and cathode. Electrochemically treated carbon fibers' surface microstructure and surface composition after alternating cathode and anode treatment in various Investigated were electrolytes. Results demonstrate that the technique may deepen the grooves on the surface of the carbon fiber; Sulfuric acid, phosphoric acid, sodium sulphate, and sodium phosphate are the electrolytes when the C content on the carbon fiber's surface decreases as the O content rises, and the tiny. It was revealed that ammonium bicarbonate had an impact on the carbon fiber's surface element; But each selected electrolyte can substantially raise the oxygen functional groups. COOH content on the surface of the carbon fiber. The anodic treatment of carbon fibers in various electrolytes. The process's oxidation mechanism differs. treated carbon fibers by alternating electrochemical. The diameter of the carbon fiber, the crystal lattice spacing d(002), and the anode and cathode all rise at both at once.

1.3 Specifications

1.4 Procedure

- By turning the initial setting knob to zero, the load pointer is set.
- The specimen for calculating minor amounts of elongation is fixed, along with the dial gauge.
- Determine the mean value and note the gauge length after measuring the test piece's diameter using a vernier calliper at least three times.
- The specimen is now held between the m/upper c's and middle cross head jaws.
- Configure the system for automatic graph recording.
- Turn on the machine and take a reading.
- The specimen is gradually loaded, and the lengthening is documented up until the specimen breaks.

1.5 Observation

1.6 Calculation

1.7 Precautions

- The specimen needs to be prepared in the appropriate sizes.
- The specimen must be set up such that it can fit between the jaws.
- Read the material attentively.
- Stop to m/c after breaking the specimen.

1.8 Results

1.9 Refences

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2 Stereo Microscopy Experiment

2.1 Introduction

Stereo microscopy is a sort of light microscopy that is made for low magnification observation and uses a light source to reflect light onto the surface of the sample. The user is provided with slightly different viewing angles for each eye using two viewing and objective parts. Instead of the two-dimensional picture seen with a single objective piece, this design enables a sample to be viewed as a three-dimensional image. In order to investigate the surfaces of solid samples, such as those utilized in crack failure analysis and quality control analysis, stereo microscopy is frequently used. Typically, optical fiber light sources with halogen bulbs are utilized as the light source because they make it easy for users to change the light's angle. Due to the 3-D nature of the samples, light modification is crucial for highlighting and illumination. Places of interest on the surface of the sample that are at a lower depth than other areas may cast shadows due to a fixed light source. In general, stereo light microscopy is the best choice when less than 100 x magnification observations are needed, the sample is three dimensional, or you want to handle, dissect, or operate on the sample while it is magnified.

Figure 2-1 Stereo microscopy

Capabilities

- Digital Imaging & Capture
- Uses reflected illumination
- Calibrated length measurement
- Macro fracture features

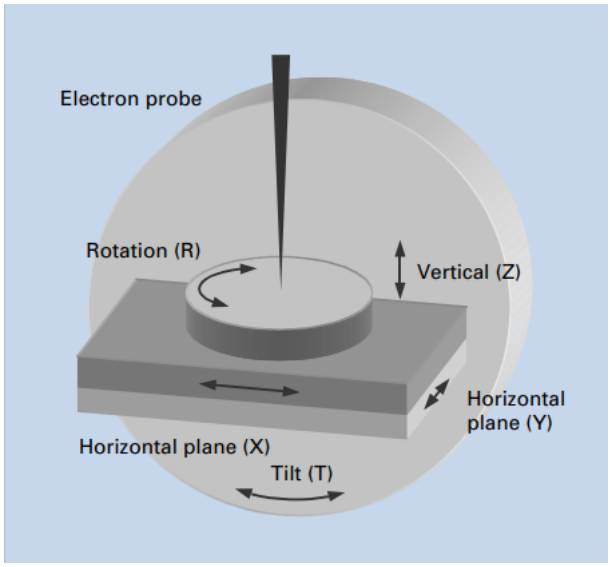

Figure 2-2 Specimen setup

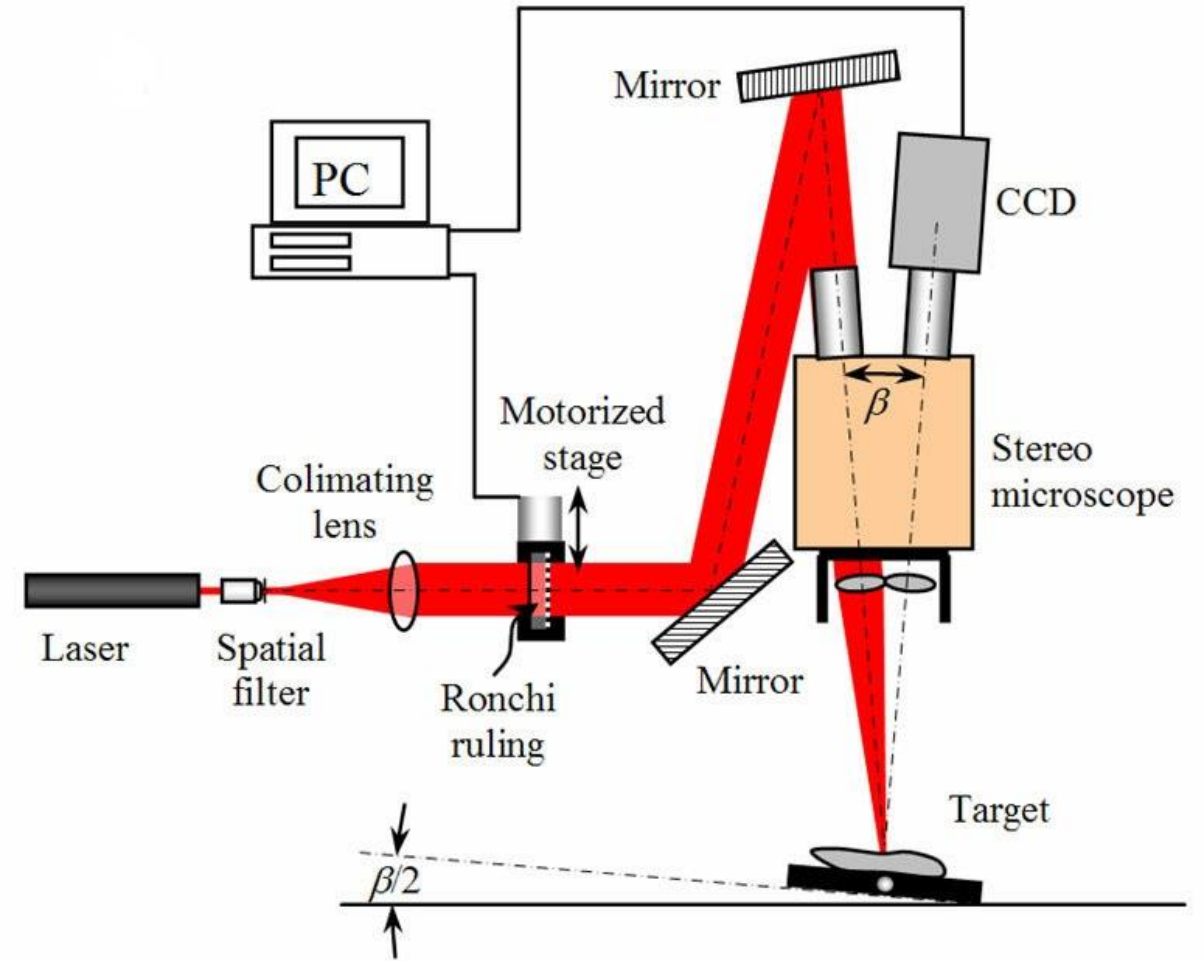

Figure 2-3 Internal view of Stereo Microscopy

2.2 Procedure

- The Transmitted/Oblique Illuminator should be turned on. A card, coin, or any other flat, textured object can be used as a small solid specimen that is placed on the stage.
- Use the focus control to sharpen the image after lowering the Magnification adjustment knob.
- To fit the needs, adjust the eyepieces' interpupillary distance. To achieve this, adjust the eyepieces' distance from one another until just one field of view is visible. Set both eyepieces' Dioptric adjustment rings to zero at this point.
- To set the highest magnification, turn the Magnification adjustment knob. Use the focusing knob to bring the image into focus. Center the photo on a distinct feature of the specimen.
- Using the Magnification adjustment knob, lower the microscope's magnification to its lowest setting. The picture could be a little bit out of focus.
- Never use the focusing knob to change the focus. By utilizing the eyepiece Dioptric adjustment rings, you can individually adjust the focus for each eye. Now that your microscope is "parfocal," This implies that the picture will remain in focus over the whole zoom range of the microscope, from high to low magnification. The environment will differ for each person.

2.3 Results

2.4 Refences

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3 Vickers Hardness Experiment

3.1 Introduction

The Vickers hardness test is used to gauge a material's hardness, particularly for thin portions and small components. A diamond indenter and a light load are used to create an indentation on the object being tested. The object's hardness value is calculated based on the depth of the indentation.

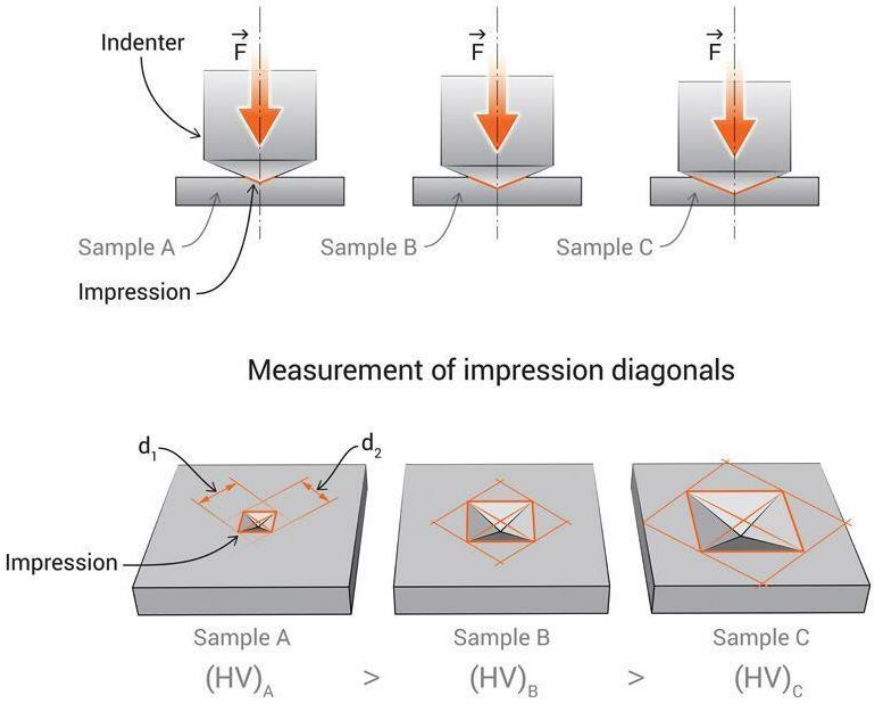

Figure 3-1 Vickers Hardness Test indentation examples

The harder the object, the smaller the indentation. Similarly, if the indentation is substantial, the material lacks toughness. Many companies use this test to decide what kind of material to employ for equipment and operations. A material should be chosen whose hardness is optimal for the intended use.

Figure 3-2 Diamond Tipped Indentor

Microhardness testing is another name for the Vickers hardness test.

3.2 Procedure

A specific indenter is used to push into the surface being tested during the Vickers hardness test. Unlike other methods of hardness testing, such the Rockwell hardness test, it only uses one test force. Using eyepieces and powerful magnification devices like microscopes, the resulting indentation is measured. Some people go as far as to use analysis software in order to get quicker and more precise results.

The macro range of the Vickers test is between 1 and 100 kilograms, and the micro range is between 10 and 100 grammes. In both ranges, the same indenter is employed. As a result, the hardness values generated are constant across the whole range of metal hardness.

The Vickers test can be particularly helpful for applications like checking extremely thin items like foils because it leaves a little impression. Additionally, it is perfect for assessing the case depth hardening by splitting parts and creating an indentation series to produce a hardness change profile. It is also great for measuring small surfaces or parts, single microstructures, and small surfaces or parts.

Sample preparations are required to get accurate findings. The sample must be sufficiently tiny to fit within the tester. To obtain a consistent indentation shape and accurate measurement, the preparation should also have a smooth surface. Additionally, this guarantees that the subject can be held perpendicularly to the indenter.

3.3 Observation

3.4 Calculation

3.5 Precautions

To prevent interaction between the work-hardened regions and effects of the edge, the minimum spacing between indentations and the distance from the indentation to the specimen edge must be taken into consideration when performing the hardness tests.

3.6 Results

3.7 Refences

- Mitchell, M.R., Link, R.E., FilhoP.P.R., Cavalcante, T. da S., de Albuquerque, V.H.C. and TavaresJ.M.R.S. (2010). Brinell and Vickers Hardness Measurement Using Image Processing and Analysis Techniques. Journal of Testing and Evaluation, 38(1), p.102220. doi:10.1520/jte102220.
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4 Scanning Electron Microscope (SEM)

4.1 Introduction

Particularly in the last few years, as the size of materials utilized in diverse applications has continued to decrease, scanning electron microscopes (SEMs) have developed into strong and adaptable tools for material characterization.

Similar to how light microscopes employ visible light, electron microscopes use electrons for imaging. SEMs employ the electrons that are reflected or knocked off the near-surface portion of a sample to form an image, in contrast to transmission electron microscopes (TEMs), which detect electrons that pass through an extremely thin specimen. The resolution of SEMs is greater than that of a light microscope because the wavelength of electrons is substantially shorter than that of light.

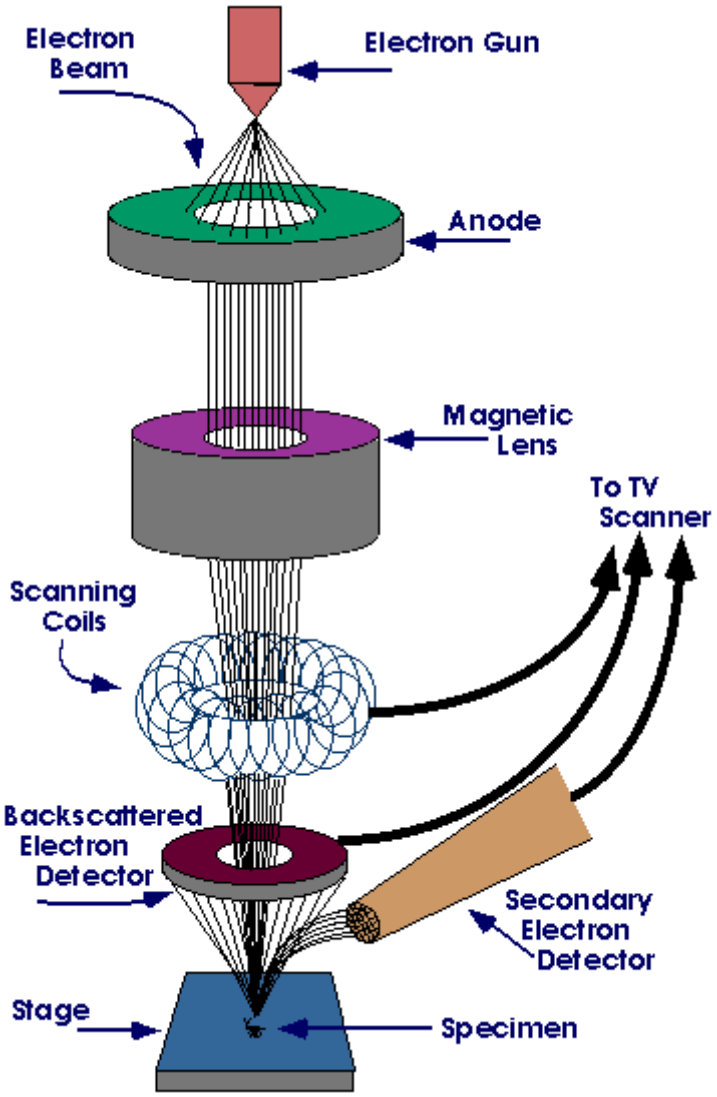

Figure 4-1 SEM

Working of SEM

In scanning electron microscopy, the sample is scanned sterically by the electron beam. First, the electron source at the top of the column produces electrons. These are released when the source material's work function is surpassed by their thermal energy. The positively charged anode then accelerates and attracts them.

There must be complete vacuum throughout the electron column. The electron source, like every other part of an electron microscope, is enclosed inside a distinct chamber to maintain vacuum and shield it from impurities, vibrations, and noise. Vacuum not only prevents contamination of the electron source but also enables the user to take high-resolution pictures. Other atoms and molecules may be present in the column if there isn't a vacuum. The electron beam is redirected as a result of their contact with electrons, which lowers the image quality. High vacuum also improves the effectiveness of the column-mounted detectors' ability to gather electrons.

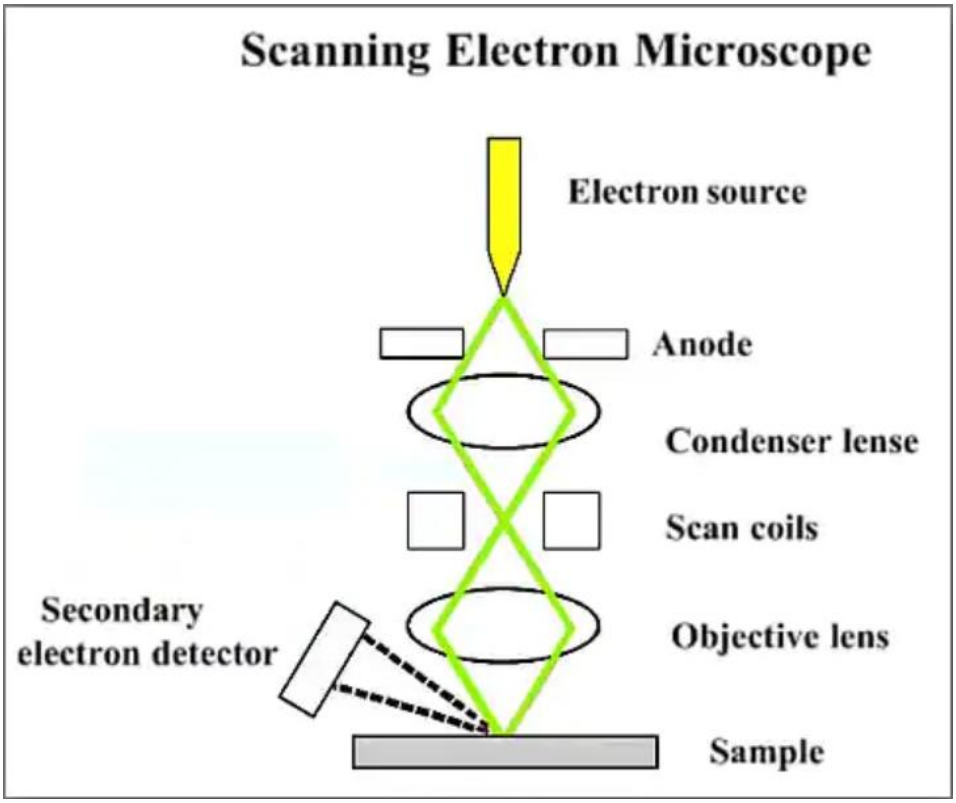

Figure 4-2 Working of SEM

4.2 Procedure

The stub of a SEM sample is attached to two-sided carbon tape, and UHMWPE powder is sprinkled on top. The sample is coated (100 times) with light gold, platinum, or carbon before being analyzed in a SEM chamber.

Preparation of the sample

Special sample preparations are required due to the vacuum environment and electron-based image formation used by the SEM. The samples must be completely dry because any remaining water would vaporize in the vacuum. Since they are all electrically conductive, all metals can be employed right away. By covering the sample with a thin layer of conductive material, all non-metals must be rendered conductive. A tool known as a "sputter coater" is used for this.

Argon gas and an electric field are both used by the sputter coater. The sample is positioned in a tiny compartment that is vacuum sealed. One electric field and argon gas remove an electron from argon, making the atoms positively charged. The argon ions are subsequently drawn to a gold foil that is negatively charged. The gold atoms on the surface of the gold foil are removed by the argon ions. A thin layer of gold is created on the sample's surface as a result of these gold atoms falling and settling there.

4.3 Precautions

The X-rays generated during the process as well as the electrons that are backscattered from the sample are the sources of the radiation safety concerns. The majority of SEMs are very well insulated and do not generate exposure rates above background. However, because they produce radiation, scanning electron microscopes should at the very least be inventoried. The machines must be

registered with the Indiana State Department of Health's office using State Form 16866, Radiation Machine Registration Application. Additionally crucial are the preservation of the shielding's integrity, the proper operation of all existing interlocks, and personnel' awareness of radiation safety precautions.

4.4 Results

4.5 Refences

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