**Matric number; 16/MHS03/018**

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**Course tittle; Electron microscopic technique and ultrastructure**

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**Assignment**

1. Write an essay on the history of microscopy

**Early Light Microscopes Developed**

During the 1590s, two Dutch spectacle producers further experimented with these early lenses. Zaccharias Janssen and his father Hans Janssen realised that if you put a small object in a tube containing several lenses, the object would appear very large when at the end of the tube and was much more enlarged than when a simple magnifying glass was used.The pair only achieved a magnification of 9x and these early microscopes were more novelties than scientific instruments.In the late 17th Century, Anthony von Leeuwenhoek from Holland invented a single lens, hand-held microscope that could achieve a magnification of 270x.Using this lens, he went on to develop the first microscope that could actually be made use of. Leeuwenhoek found he was able to see structures that noone had seen before such as blood cells and bacteria.In the same century, Englishman Robert Hooke was acknowledged as having discovered the smallest most basic unit of an organism – the cell.He was also recognised as the first person to use a microscope with three lenses, the configuration used in today’s microscopes.

**Microscopes go into Large Scale Production**

There were few further developments made to the microscope until the middle of the 19th century, when sophisticated microscopes such as the ones we use today were developed. The German company Zeiss started to manufacture these refined devices.During these early years, scientists worked to solve various problems with the microscopes, such as the unequal bending of light that hits the lens in different places. In 1830, Joseph Lister, realized that placing the lenses at specific distances from one another resolved this problem for all but the first in the series of lenses.For the first lens, use of a low power lens with low curvature minimized this unequal light bending to the extent that the problem was almost eliminated.

**Phase-Contrast Microscope Developed**

Frits Xernicke developed the phase-contrast microscope in 1932. This device enabled researchers to study transparent biological materials.

**Electron Microscope Appears**

The use of visible light in microscopy limits the resolution that could be achieved, but this was problem was overcome in 1931 when two German scientists Max Knoll and Ernst Ruska discovered that beams of electrons could be used instead of light. The electron microscope could to be used to observe objects that were not visible using light microscopes.Scientists working for corporations competed to develop the first commercial electron microscope and Ernst Ruska, working for Siemens, eventually achieved this in 1938. By the late 1930s, microscopes had been developed that could achieve resolutions as low as 10nm and by the mid 1940s, resolutions as low as 2nm had been achieved.The main competitors in Europe were Siemens, Philips and Carl Zeiss. In the late 1930s, the scientists in Japan formed the Japan Electron Optics Laboratory that eventually manufactured the greatest variety of electron microscopes among all of the companies.The early versions of electron microscopes used transmission electron microscopy. The first scanning electron microscope hit the market in 1965, which revolutionized the world of material science.

## 2) Light Microscope vs Electron Microscope

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| **Difference Between Electron Microscope And Light Microscope** |
| **Light Microscope** | **Electron Microscope** |
| Uses light ( approx 400-700 nm) as an illuminating source | Uses electron beams (approx 1 nm) as an illuminating source. |
| Lower magnification than an electron microscope | Higher magnification |
| No risk of radiation leakage | Risk of radiation leakage |
| Specimen preparation takes about a few minutes or an hour | Specimen preparation takes several days |
| Both live and dead specimen can be seen | Only dead and the dried specimen can be seen |
| The image formation depends upon the light absorption from the different zones of the specimen | The image formation depends upon the electron scattering |
| The image is seen through the ocular lens. No screen needed | The image is received on a zinc sulphate fluorescent screen |
| Useful magnification of 500x to 1500x | Direct magnification as high as 16000x and photographic magnification as high as 1000000 x |
| Low resolution | High resolution |
| Inexpensive and requires low maintenance cost | Expensive and high maintenance |

## 3) The difference between SEM and TEM

The main difference between SEM and TEM is that SEM creates an image by detecting reflected or knocked-off electrons while TEM uses transmitted electrons (electrons which are passing through the sample) to create an image. As a result, TEM offers valuable information on the inner structure of the sample, such as crystal structure, morphology and stress state information, while SEM provides information on the sample’s surface and its composition.

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|   | **SEM** | **TEM** |
| **Type of electrons** | Scattered, scanning electrons | Transmitted electrons |
| **High tension** | ~1 – 30 kV | ~60 – 300 kV |
| **Specimen thickness** | Any | Typically <150 nm |
| **Type of info** | 3D image of surface | 2D projection image of inner structure |
| **Max. magnification** | Up to ~1 – 2 million times | More than 50 million times |
| **Max. FOV** | Large | Limited |
| **Optimal spatial resolution** | ~0.5 nm | < 50 pm |
| **Image formation** | Electrons are captured and counted by detectors, image on PC screen | Direct imaging on fluorescent screen or PC screen with CCD |
| **Operation** | Little or no sample preparation, easy to use | Laborious sample preparation, trained users required  |

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**References**

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