

Applications of microscopes in different fields of forensic science

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ABSTRACT

The microscope is a tool which can be used in any kind of forensic investigations. An important part of forensic is to detect, identify and analyze trace evidence that are found at a crime scene. Forensic microscopy is not regarded as a different branch in forensics, as it is one of the techniques that are involved in the process of analysis of various evidences. Different types of microscopes provide different properties and aids. The types of microscopes indispensable in forensic investigations are stereomicroscope, comparison microscope and scanning electron microscope. Microscopes are used in various fields of forensic science including forensic criminal science, forensic anthropology, forensic epidemiology and forensic pathology.

KEYWORDS- *Microscopy, microscope types, forensic microscopy.*

1.INTRODUCTION-

Microscopy is not regarded as a different discipline as it is only one of the different techniques that are used in the analysis process of evidences.[1]The most important part in any forensic investigation is the detection, identification and the analysis of the evidence. For the purpose of the analysis of different types of evidences different microscopes are used. Microscopy is the technology which is capable of analyzing microscopic samples found at the crime scene like fragments of hair, fibers, fingerprints etc, which can provide very important information that can help in giving direction and even solving a case. In the crime involving the use of gun, there is a presence of residue called the gunshot residue(GSR). The analysis of this residue is aided by scanning electron microscope which can help in the identification of the weapon used and also the suspect[2]. In cases involving shattering of glass, the glass fragments can be compared with the help of microscope. Different types of glass have different compositions which allows the scientists to analyze its origin by looking closely. As such the use of microscope in forensics aids the examination of minute details of the evidence which helps in their individualization.

1.1 TYPES OF MICROSCOPES WHICH ARE INDESPENSIBLE IN FORENSIC INVESTIGATIONS:

Keeping in mind the various forensic applications, following are the type of microscopes whose importance in the forensic analysis is indispensable:

- **Stereomicroscope:** *The stereoscopic, dissecting microscope is an optical microscope that is designed for low magnification of a sample. In this instrument, the light is reflected from the surface, instead of transmitting through the object. The instrument uses two separate optical paths with two objectives and eyepieces to provide slightly different viewing angles to the left and right eye. This arrangement produces a three-dimensional visualization of the sample being examined.*
- **Comparison microscope:** *These are compound light microscopes that sit side by side and allow the user to view both specimens through a centre eyepiece that displays both images. This helps the examiner to compare both the specimen and the standard side by side and can conclude the observation.*

- **Scanning electron microscope:** A SEM uses focused beams of electrons to render high resolution, three-dimensional images. These images provide information on topography, morphology, and composition. Electrons are generated at the top of the column by the electron source. They are then accelerated down the column that is under vacuum, which helps to prevent any atoms and molecules present in the column from interacting with the electron beam and ensures good quality imaging.[3]



Fig-1: Stereomicroscope [12]



Fig-2: Comparison microscope[13]



Fig-3: Scanning electron microscope [14]

2. APPLICATIONS OF MICROSCOPE IN VARIOUS FIELDS OF FORENSIC SCIENCE:

MICROSCOPY IN CRIMINAL SCIENCE:

Since 1800s microscope is used in solving crimes and is the most used instrument in the crime laboratory. Microscopy in criminal science can help in the trace evidence analysis like fiber, fingerprints, hairs etc, which can be found at the crime scene. In case of use of guns for a specific crime, microscopes can be used to check and compare the striations on the bullets. Gunshot residue left at a crime scene can also be analyzed to link a specific weapon and suspect to a crime scene, which is a chemical residue that is left behind when a shot is fired from a gun. The particles of gunshot residue are very minute in size, ranging from nanometers to microns. As such Scanning electron microscopy and x-ray spectroscopy is used for the analysis of the gunshot residue which can help us to know about size, shape, and composition which can help to find out the specific composition which can be assigned to a weapon that was used during the crime. Often shattered glass present at a crime scene or accident can be examined with the help of microscope, as the glass has varying compositions and hence can help in establishing a link between crime and suspect. [4,5,6]

MICROSCOPY IN FORENSIC ANTHROPOLOGY:

Anthropology is the field of forensic science that deals with determination of cause of death .In it the several body tissues and bones can be examined under the microscope to determine the cause of death .Scanning electron microscopy is used to check the soil from where the body of the victim was found to know about the time span till which the body was present at the location .Also the trauma on the bones which can tell us about the injuries which caused or did not cause the death of the individual and how much fatal they were . It can also help in determining if the trauma was accidental or was the victim attacked by someone using a weapon .Also the path of the bullet in the human body can be discerned microscopically.[7] The coating of teeth is examined with the help of microscope , which can help researchers in concluding very helpful information about the victim like habits, ailments or cause of death in some cases .[8]

MICROSCOPY IN EPIDEMIOLOGY:

In forensic epidemiology microscopy is used for gaining clues about origin and path of the outbreak of certain disease. It is a combination of epidemiology and forensic medicine .It is concerned with gaining understanding about the control of a disease and also about many factors that are linked to human health .Mostly it provides answers to how a death occurred during civil and criminal lawsuits. Microscopes can be used in the scenario of cases including medical negligence, apparent adverse effects of pharmaceutical drugs , medical device etc .For example , to know about the source of a bacterial strain , forensic epidemiologists need to investigate the food under suspicion employing the use of microscopes for the same to clarify if the suspected food is contaminated or not . The data like this can act as a key information in a court case. This can also help in checking further contamination and thus preventing the outbreak by containing the individuals who might have come in contact with the dangerous strain of bacteria. Medical negligence claims are also, aided with microscopes although they are used along with several other methods[9]

MICROSCOPY IN FORENSIC PATHOLOGY:

Forensic pathology also revolves around finding the cause of death of an individual , in this aspect it is similar to that of forensic anthropology .Microscopes in forensic pathology gives understanding about the organelles, ducts and molecules present in the human body .The traces of bullet , knife , tool etc which were responsible for the death of an individual are easy to identify under the scanning electron microscope . Microscopes in this field are used to check the injuries and wounds on the body to determine their contribution to the death. It can also be used to check the presence of virus, bacteria in the body of deceased .[9] In case of explosion investigation the identification of the body is done with the help of the observation of the denture of the individual. Microscope is involved in the estimation of age of the injuries , changes in body due to adverse effects of drug abuse, trauma to CNS and several other aspects in case of drowning . rape etc . [10]

3.FUTURE SCOPE:

Microscopy are examined with particular reference to possible future developments. The scope for systematic improvement of the traditional optical or electron designs and procedures seems far from exhausted. However the introduction of novel, lens-free microscopes which, like the scanning tunneling microscope, produce magnification using an electronic lever arm, could expand the boundaries of the subject most dramatically. The future microscope experts may find himself displaced from the more routine tasks of focusing, alignment, image recording and even simple interpretation by the electronic robot. On the other hand, he will gain access to a wider and more sophisticated range of physical and chemical phenomena governing the interaction between the specimen and the radiations he uses to probe its microscopic structure and properties [11]

4.CONCLUSION:

We can conclude that the scope of microscope use in forensic science is very wide. It allows the forensic experts to analyze various types of evidences that are obtained from the crime scene which have an immense importance in illuminating the crime that has taken place.

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