

Different eyes, different views. Scanning Electron Microscopy applied to forensic investigations

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The Scanning Electron Microscope (SEM) is an extremely versatile instrument, essential in a wide array of applications in forensic analysis: for example, it is used to analyze gunshot residue, bullet fingerprints, bullet wipe or patterns around the bullet hole, to examine traces of foreign material embedded in or adhered to bullets (which can provide critical information in the trajectory reconstruction of spent bullets); to study environmental dusts, fibers (both natural and artificial) and to identify unknown small particles; to detect non visible blood stains; to analyze diatoms in drowning cases; and for ink and paper analysis. One central feature of SEM is its ability of providing both panoramic and highly magnified views of the same sample, giving an almost 3D view of the specimen. It is the ideal trait d'union between macroscopic information collected during autopsic or investigative activity and microscopic information obtained with the light microscope. Above all, SEM allows performing a progressive and targeted microdissection of the sample. In this presentation, a selected number of investigations are shown in order to illustrate through specific cases general purpose applications. An elderly man was killed with several blows of axe at the head. SEM investigation allowed us to reconstruct the sequence of the blows, to recognize the type of weapon, to determine how this latter was used and how sharp it was. These results allowed the police to reject the initial version of the suspected, which was eventually convicted of willful murder. A young man died with multiple traumatic and fulguration lesions. SEM analysis allowed us to perform a detailed study of the burnt tissue and to reconstruct the path of the electric discharge, concluding that the primary causa mortis was an accidental electrocution, which caused the subsequent trauma. A child died of a sudden, dramatic internal bleeding. The autopsy revealed that some time before she had swallowed a coin battery which had become lodged in the oesophagus. Here the decaying products of the battery caused an electro-chemical dissection of the oesophagus and, finally, of the descending aorta. The SEM analysis revealed the details of the progressive degeneration of the surrounding tissues.

Keywords

SEM; forensic.