



Pathology/Biology Section - 2013

G91 How to Scan Hot Stuff: Scanning Electron Microscopy Applied to Forensic Investigations

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After attending this presentation, attendees will discover that scanning electron microscopy has a wide number of possible applications in forensic investigations. Attendees will also have a general understanding of the advantages of scanning electron microscopy in forensic analysis. They will be shown that the Scanning Electron Microscope (SEM) is not only a mere tool, but is an actual method of forensic investigation which requires operators to see the possibility of performing this analysis at the time of autopsy and/or when samples are collected.

This presentation will impact the forensic science community by demonstrating various methods in which organic and inorganic samples may be analyzed with an SEM and by providing elements to better understand the evolution and application of this technology to forensic cases.

Since it is a versatile instrument, the SEM is widely used in forensic investigations. It is used to study a large variety of specimens in forensic investigations such as the analysis of gunshot residue, bullet fingerprints, bullet wipe or patterns around the bullet hole, environmental dusts, fibers (both natural and artificial), and ink and paper analysis.

In this presentation, a selected number of investigations are shown, to illustrate through specific cases, general purpose applications: SEM has the 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 autopsies or investigative activity and microscopic information obtained with the light microscope. Above all, the SEM is an instrument that allows to perform a progressive and targeted microdissection of the sample, possibly at the time of autopsy and/or the collection of the sample.

This presentation will focus on the experience gained over the past four years by the Forensic Laboratory, a multi-discipline unit of the University of Insubria. At the Human Anatomy Laboratory, the sample, collected during the forensic investigation, is reduced, when necessary, to an appropriate size to fit in the specimen chamber, then prepared to be observed under the scanning electron microscope (FEI Philips XL-30 FEG-SEM microscope).

After a preliminary analysis, usually made by both secondary electrons detection (which shows the morphology of the sample surface) and detection of backscattered electrons (since high atomic number elements backscatter electrons more strongly than low atomic number elements, back scattered electron images show areas with different chemical composition as zones of different brightness over the sample), the sample is prepared once again: it is subjected to an osmium tetroxide maceration post fixation process in order to enhance membrane contrast and to better visualize intracellular structures and/or it is prepared by NaOH 1N maceration, when a better evidence of connective tissue stroma is desired. In these cases, the specimens are mounted on adhesive films applied on standard aluminium stubs, gold coated in an Emitech K550 sputter coater (Emitech Products Inc.) and then observed under the scanning electron microscope.

When the situation requires it, energy dispersive X-ray spectroscopy and X-ray mapping of specimens are performed, to identify the elemental composition of the whole sample or small area of interest on the sample.

SEM, EDS Microanalysis, Bloodstains