

Human Hair Analysis using Synchrotron-Radiation-based Fourier-Transform Infrared Microspectroscopy

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Human head hair can be used in helping for reconstruction of events. It remains identifiable on bodies in an advanced state of decomposition or attached to a murder weapon long after the crime is committed. Hair analysis can provide vital information concerning important chemicals that may be in the body. The presence of various toxins and nutrient deficiencies or abundances can be determined using FT-IR microspectroscopy being one tool that can be used for examination of the interior of the hair and differentiate passive contamination from drugs absorbed into the hair from ingestion.

Detailed mapping of human head hair was accomplished with utilization of synchrotron-radiation-based Fourier transform infrared (SR-FTIR) microspectroscopy. Paraffin-embedded human hair from different persons was sectioned transversally on a low-e slide for mapping. Mapping with an $10\ \mu\text{m} \times 10\ \mu\text{m}$ aperture provided detail of the spatial distribution of chemical composition within the hair. The medulla was the densest region and contained sulfur-rich material, as evidenced from the greatest absorbance of asymmetric stretching and symmetric stretching vibration wavenumber of S=O at band position of $1209\ \text{cm}^{-1}$ and $1053\ \text{cm}^{-1}$, respectively. In additions, the peak areas of $1650\ \text{cm}^{-1}$ (amide I) and $1530\ \text{cm}^{-1}$ (amide II) bands showed a higher concentration of the cortex and the medulla. The spectral images of components of hair showed the quite differences among different individuals based on the absorbance of different secondary structure of protein and chemicals distributed within the hair. Thus, infrared microspectroscopy may be a fast, suitable and non-invasive method for forensic analysis of hair.