

APPLICATIONS OF INFRA-RED SPECTROSCOPY IN FORENSIC INVESTIGATION: A REVIEW

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ABSTRACT: IR spectroscopy has been used for examination and quantification of even trace evidences found at crime scene. IR is the absorption phenomena w.r.t Molecular vibrations within the sample. This review consists of number of evidences examined under IR spectroscopy. IR spectrometer is used for analysis of evidences and the results are given. Research into a variety of areas related to analysis of crime scene evidences is ongoing, and will continue to improve the quality of different trace evidences like explosives, drugs residues examination.

KEY WORDS:

Spectrometer, trace evidences, explosive materials.

INTRODUCTION: Spectroscopy is the study of the interaction of light with molecules. Infrared spectroscopy is the interaction of infrared light with the matter. IR extends from the nominal red edge of the visible spectrum at 700nm to 1mm. IR was discovered by Sir **William Herschel**, who discovered a type of invisible radiation in the spectrum lower in energy than red light[1]. **Principle of IR :** IR spectroscopy is based on the absorption of infrared radiation, which causes vibrational transition in the molecule. Infrared spectroscopy is the technique in which the measurements of different IR frequencies by a sample are done, positioned in the path of IR beam [2]. IR spectrometer can accept wide range of sample types such as gases, liquid and solids. Depending on the nature of evidence, a wide range of analytical methods are used for investigation purposes. There are different kinds of evidences which can be found at the crime scene like latent fingerprints, fibers, paint chips, documents, explosives materials etc. This review illustrates different types of evidences examination under IR spectroscopy.

Materials & Methods: Different types of evidences are examined in this study like examination of copy toners, fibers, paints,

Tapes, drugs, explosives etc are studied under IR spectrometer. The instrument used for examination purposes is Infrared Spectrometer which gives the quantification analysis. Some evidences examined are:

Fibers: According to Locard’s exchange principle, in violent crimes like murder, rape the textile fibers are transferred between clothing during personal contact. Therefore fibers can be transferred from the suspect to victim or vice versa. To study fiber type IR is very useful specially to identify subclasses of synthetic fibers.[3,4]. IR is useful for sub classifying acrylic fibers used in sweaters.

- ✓ **A spectral library of 83 polymeric fiber types were obtained by transmission of IR on flattened single fibers, was developed to aid forensic examiners for identification of fiber composition [5,6].**

Paints: In a variety of crime scene scenarios, IR spectroscopy of paints has been useful in forensic analysis [7,8].

- ✓ With IR, organic binders are frequently identified and also organic and inorganic pigments can be examined. Inorganic pigment components in paint have revealing a spectral feature at lower wave numbers and DTGS-deuterated triglycine sulfate detector is used. IR analysis on automotive paint used to identify make, model and year of vehicles is readily searched in databases.[9,16]

Copy Toners: In some crimes, some fraud, threatened documents and letters are generated on printers, copy machines. Therefore, by comparing the resins of toners used as ink the identification of machine model can be achieved.[5]

- ✓ In this study, sample pages were prepared from 62 models and forwarded to laboratory. IR was used as heat transfer technique to remove toner from documents. Significant variations in IR spectra were produced by polymeric resins which contains numerous additives.[5,6]

Drugs: IR also used for drugs analysis both licit and illicit [10, 11]. The computerized drug library produced at the Georgia **State Crime Laboratory** is a standard in forensic analysis. IR used with GC to simplify drug mixture analysis

- ✓ Along with GC when IR was used it becomes more effective indifferentiating diastereoisomers.

The identified compounds were ephedrine & pseudo ephedrine.[5]

Art Forensics: IR spectroscopy used for the first time for analysis of 12 inorganic pigments that are in common use by artists today like cobalt blue, ultramarine blue, Prussian blue, azurite etc[8].

- ✓ Several overtone and combination bands were detected that are useful for inorganic pigment identification [12]

ESSENTIAL OIL: Cinnamon bud oils, Ravintsara and Ravensara oils were obtained for comparison purposes, essential oil of these plants obtained from US companies. Samples were analyzed by placing in quartz cuvettes and scanned 10 times in the range 300-2500nm by using portable NIR spectrometer.

- ✓ The composition of the cinnamon and clove oils were obtained similar, being dominated by eugenol (59-82 and 69-81 respectively) [13]

Explosives: Explosives produce unique IR spectra, thus makes IR useful for identification of major components in bulk explosives [14]. Keto demonstrated an extraction method for determination of C-4 military explosives and this gives better result when analyzed under IR spectrometer [15].

Conclusion: Infrared spectroscopy is useful in forensic investigations because much of the evidence that is left at a crime scene consists of organic compounds. The organic compounds May that may be accelerants in arson cases or

plastics in structure like cars, furniture, implements and also clothing. IR Spectroscopy can also be used in identification of forged or altered documents by shining a beam of infrared light on the document's ink. It appears that Infrared Spectroscopy proves to be an analytical tool for identification of evidences found at crime scene. The no. of evidences can be examined under IR like inorganic pigments in cultural artifacts, paint chips, art forensics, fiber analysis, explosives etc.

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