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# CUESTIONES POLÍTICAS

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# Application of Innovative Technologies for Detection and Investigation of Evidence in Criminal Proceedings

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## Abstract

The main objective of the study was to demonstrate the hypothesis that the use of an infrared spectroscopy method for the investigation of objects of examination allows to obtain important and reliable data that can be used in criminal proceedings. The authors explain that knowledge of the possibilities and procedures for using new methods of scientific research is necessary not only for experts, but also for other participants in criminal proceedings who evaluate the evidence. Through the documentary method focused on specialized literature on the subject, special sources of literature on the application of the IR spectroscopy method for the investigation of individual objects and the analysis of possibilities and establishment of the great importance of its use in judicial practice in general were reviewed. It is concluded that, studies show that the use of infrared spectroscopy can not only increase the level of scientific and technical support of legal medical practice, but also improves the quality of expert research and therefore increases confidence in the accuracy and reliability of conclusions made by an expert.

**Keywords:** infrared spectroscopy; forensic examination; preparation of muster; to theorem of research; evaluation of the conclusion.

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## Uso de técnicas innovadoras para la revelación e investigación de pruebas en un procedimiento criminal

### Resumen

El objetivo principal del estudio fue demostrar la hipótesis de que el uso de un método de la espectroscopia infrarroja para la investigación de objetos de examen permite obtener datos importantes y confiables que pueden ser utilizados en procedimientos penales. Los autores explican que el conocimiento de las posibilidades y procedimientos para utilizar nuevos métodos de investigaciones científica es necesario no solo para los expertos, sino también para otros participantes en el procedimiento penal que evalúan la evidencia. Mediante el método documental enfocado en literatura especializada en el tema se revisaron fuentes especiales de literatura sobre la aplicación del método de espectroscopia IR para la investigación de objetos individuales y el análisis de posibilidades y establecimiento de la gran importancia de su uso en la práctica judicial en general. Se concluye que, los estudios muestran que el uso de la espectroscopia infrarroja no solo puede aumentar el nivel de apoyo científico y técnico de la práctica médico legal, sino que también mejora la calidad de las investigaciones expertas y, por lo tanto, aumenta la confianza en la exactitud y confiabilidad de las conclusiones hechas por un experto.

**Palabras clave:** espectroscopía infrarroja; examen forense; preparación de muestras; algoritmo de la investigación; valoración de la conclusión.

### Introduction

The appointment and conduct of forensic examinations in criminal proceeding is important for the collection and verification of the evidence by the side of the prosecution and by the side of the defense, and the evaluation of their results by the court is often key to making a lawful and correct court decision. The character and properties of many objects of examination necessitate the use of the various physical and other scientific methods for its research. The use by forensic experts of high-precision modern equipment and devices, the application of the innovative technologies and the latest scientifically sound methods of research makes it possible to obtain complete, accurate, reasonable, and illustrative results, which can be in the basis of expert conclusion.

At the same time, the knowledge modern possibilities of expert researches and methodic, which can be used for its carrying out by the investigator, prosecutor, lawyer, of the main rules and procedure of the obtaining and preparing various objects as samples of examination enables

the procedural person, who asks about an examination, to appoint it in a timely manner, properly prepare objects and evaluate the results that has been obtained by the expert. All this affects the completeness, objectivity and impartiality of the pre-trial investigation and trial of the materials of the criminal proceedings, and ultimately is aimed at ensuring of the compliance with the fundamental rights and interests of the individual. Unfortunately, in some cases, experts do not apply the latest methods and methodic of research on their own initiative, and investigators and the side of defense, without relevant information, do not indicate the need for their application.

In other cases, the procedural person who evaluates the conclusion of the expert has no knowledge about the possibilities of certain or other scientific methods and therefore unable to properly assess the conclusion of expert. All this is directly related to the use of the expert in the study of a number of the physical evidence and other objects of the latest methods of the infrared spectrometry. The information about the possibilities and tasks of such methods of the research is of undeniable benefit to both the expert and the procedural persons, who turn to him for help in gathering and evaluating of evidences.

### **1. Materials and methods**

The review of special literature sources on the issues of the application of the method of IR-spectroscopy for the research of individual objects and analysis of the opportunities and establishing the importance of its use in the forensic practice.

### **2. General provisions of the use of method of infrared spectrometry for the research of several objects**

The essence of the method of the infrared spectrometry.

Today, it is difficult to imagine conducting a pre-trial investigation into most criminal proceedings without using help of the specialists in various fields of knowledge, science, technology, or crafts in it by the investigator, the prosecutor, and often the side of the defense. The relevant procedural persons apply to forensic experts, involving them for holding examination for the receiving assistance in collecting and evaluating already collected evidences. The documents, weapon and other instruments of crime, various traces and other material objects, for the research of which requires the application of the full range of advanced achievements of scientific and technological progress most often become the objects of forensic examination.

In the current practice of pre-trial investigation, the latest scientific and technical means are widely applied, the capabilities of which are constantly expanded, new are created and existing methods of detection and research of various objects are improved, which become material evidences in criminal proceedings. In many cases, for a qualitative and complete research of samples, the experts need to use complex but quite effective scientific methods. Namely, such is the method of the infrared spectroscopy (IR-spectroscopy) as one of the most effective modern methods, which is applied for expert analysis and identification of various objects and substances. The infrared spectroscopy is the section of the spectroscopy that studies the interaction of the infrared radiation with different substances. As one from the physical methods of the researches, it is used in the different areas of the science, technic, production and in each of them this term is given a different meaning, and the study itself and different meanings are given for its results.

The method of infrared spectroscopy (IR-spectroscopy) is one of the methods of the analysis that is based on the recording infrared spectra of the absorption substance. The absorption by the substance in the area of the infrared radiation occurs due to the oscillation of atoms in molecules and has the form of a spectrum, where its own wavelength corresponds to every oscillation. Namely, the identification of substances and connections by their spectral data is based on these properties of the IR-spectra. The sets of bands in the IR-spectrum have the same specific characteristic of substances as human fingerprints. The substance can be identified by these spectra, if its spectrum of oscillation has been already known. The measurement of the intensity of the bands in the spectrum makes it possible to apply the quantitative analysis, to study the chemical equilibrium and the kinetics of chemical reactions, to control the course of technological processes, etc. The active development of different designs of spectral devices for their industrial application has begun from the end of the last century (Kolesnyk and Sapoletova, 2011).

In the pre-trial investigation of the criminal offences this method is applied for the deciphering the structure of different substances, the study and establishment of structure and content of which is important for the correct solution of the tasks of criminal proceedings. One of the tasks of the IR-spectroscopy is the quantitative determination of the values, which characterize the absorption by a certain substance of monochromatic radiation of light waves of different lengths. These values can be used both for the quantitative characterization of a certain substance and for quantitative its determination in solution or in a mixture with other substances. The results of such researches are important not only for the establishment of involvement of a certain person in committing certain actions, but also can effect on the legal qualification of the action, for example, during the investigation of crimes in the field of illicit trafficking of the narcotic drugs, the falsification and the counterfeiting of medicinal preparations, etc.

The new opportunities of the application of the method of IR-spectroscopy for solving a wide range of tasks in the forensic examination research of different objects appear with the development of the science and technic. The determination of content and form of substance by its IR-spectrum by the expert is based on the relationship of the characteristic absorption bands that are recorded in the IR-spectrum, with features of the structure of molecules of a substance that absorbs the light. The totality of all bands of the absorption, which creates the spectrum of this substance, unambiguously determines its individuality, and therefore individualizes the substance itself. The study of IR-spectrum gives opportunity to determine the most important analytical bands of the absorption, which can be used for the evaluation of the quantitative content of substance, to establish the availability of the polymorphism, to consider the nature of the impact on the IR-spectrum of the individual substitutes, as well as of another structural changes in the molecule of the substance.

The method of IR-spectroscopy is applied on the practice in conducting the expert research of objects of different nature and origin. This method is most often used for solving such tasks of the pre-trial investigation.

1. For the research of narcotic drugs, psychotropic, potent, and toxic substances and precursors (Kolesnyk and Hora, 2017; Litvin, 2009). In the examination of such objects of the IR-spectroscopy, one of the urgent tasks of the investigation is solved – the identification of the content of mixture that contains substances whose circulation is prohibited or restricted by law. To do this, it is necessary to identify each of the components of the mixture, which usually consists of the active substance and the filler. When researching the components of the filler, which for the most part cannot be identified by other expert methods, for example the chromatographic, IR-microscope that is combined with an IR-spectrometer is applied.
2. For the research of cosmetics, medicines, several substances of unknown nature (Hora, 2016; Maksitina *et al.*, 1984). During the examination of the specified objects, this method is used both individually and in the complex with X-ray fluorescence method of the analysis, the gas chromatography, the gas chromatography with the mass spectrometric detection or the high-performance liquid chromatography. In the case of analysis of substances of unknown nature, preferable the IR-spectroscopy is used, because in this case a minimum of consumables is required and a wide circle of substances can be identified organic and many inorganic compounds.
3. For the research of the paint and varnish materials and products from them (Tarutina and Pozdniakova, 1986). Microscopic layers of the paint and varnish materials on carrier objects are among the most common objects of examination of materials, substances and

products in the forensic practice. During the pre-trial investigation of many criminal proceedings, for example, about the traffic accidents, it is necessary to establish the affiliation of a significantly small number of layers of the paint and varnish coverages to the content of the paint and varnish coverage of specific cars or other vehicles of the painted structures and other objects that are inspected and with which the vehicle has had or may have contact.

The complexity of such studies is related to the analysis of micro quantities of the researched objects, as well as with many layers and multi-component of each of the layers of paint and varnish coverage. For the research of paint and varnish coverings and objects with the traces containing them, it is necessary to apply a complex of various methods, the most informative of which is the IR-spectroscopy. This method provides the ability to set the type of the main component of paint and varnish materials, the filler, and sometimes the composition of the pigments that is used in the paint. The special devices are used for this purpose – IR- Fourier spectrometers and the special devices that allow to obtain the necessary information in the study of micro particles and microscopic layers.

4. For the establishment the affiliation of substances and traces of substances, as well as gas mixtures to explosives (Kolesnyk and Hora, 2017; Examinations in the legal proceeding of Ukraine: scientific-train manual, 2015). A comprehensive research of explosives and products of explosive involves the application of a wide range of analytical methods, each of which aims to solve individual tasks to establish certain features or properties of the researched substance. The most common methods are morphological research methods, X-ray diffraction (X-ray phase) and X-ray fluorescence analysis, of molecular spectroscopy in the infrared region of the spectrum, etc.
5. For the research of toners in the strokes of the printed documents, the pastes for the ballpoint pens, the colorant markers, etc. (Examinations in the legal proceeding of Ukraine: scientific-train manual, 2015; Barannikova, 2017). The research of substance of toners and other colorants is quite common task that is performed during the technical research of the documents. It is known that such substances have a multicomponent composition that is formed from a polymer base and a large number of inorganic components. As a result, the analysis of the polymeric component of the substance is extremely difficult or impossible. In addition, today there is a tendency to the unify the quality composition of the polymer part of most toners, and therefore there is a need for their quantitative analysis. The use of the quantitative method of the IR-Fourier spectroscopy allows the overcoming these difficulties.

In addition, IR-spectroscopy is an effective method of analysis in case of examination of synthetic glue, plasticizers, fillers, and other polymers that are used to produce documents. The objects of such researches may be printed texts that are made on the printers, the copiers or the multifunction devices for the printing. In such cases, it is important to obtain information about the chemical composition of the toner in the strokes of the text of the document.

Using an IR-microscope and a special prefix to it, the method of IR-spectroscopy can be used to hold the research of fibers to establish their group affiliation and the implementation of the identification. In addition, the described method gives the chance to investigate the structures of crystals, to carry out examination of precious stones of an organogenic origin (the amber, the pearls, etc.).

### **3. The main tasks of the using the method of IR-spectroscopy**

The research of the IR-spectra of the substances makes it possible to identify them by the characteristic spectral characteristics (by the position, the shape, and the intensity of absorption bands), as well as, in the case of necessary, to determine their quantitative content in the researched samples. The principle of this method lies in the registration with the help of the spectrophotometric devices of absorption intensity by the molecules of electromagnetic radiation in the infrared region of the spectrum. The recorded and saved image of the spectrum serves as a visual illustrative material for the conclusion, which is understandable even not to the professionals.

The registration of the IR-spectrum by means of dispersion or the IR-Fourier spectrometer and the comparing it with the database allows to get the reliable result. Such spectrometers belong to the type of the multi-channel devices, which allows a significant reduction in the energy costs. At present, the base of IR-spectra of certain classes of compounds has been created and is available to the experts, who allow automatically to compare the spectrum of an unknown substance with already known ones, therefore, to detect and to identify this substance. The value of the results that are obtained with IR-Fourier spectrometer is that it is a method of the direct registration of the bands of the absorption the reflection of which is strictly individual and is characteristic only for this sample.

The main goal of the specified method is that the IR-spectroscopy along with many other instrumental methods allows the most unambiguous interpretation of the results, which are received during the expert study in the judicial process. The advantages of the method of the IR-spectroscopy with conversion using both classical and IR- Fourier spectrographs are



the high resolution of devices, the wide area of registration of a spectrum and the small time for its registration, possibility of registration of weak signals, the constructive presence in the device or possibility of connection of the electronic computer for the work management and the fixing of the necessary results. In many cases, only the IR-spectrum can be used to infer the properties of the object that is analyzed

The significant advantages of the application of this method are that:

- the IR-spectroscopy is used in the research of various substances, most often due to its versatility, the possibilities of the direct and independent identification a number of important functional groups and structural fragments in small quantities of the test substance in any aggregate state and without any significant restrictions on the physicochemical properties of the sample.
  - in the process of measurements, especially during the application of modern high-performance console and devices, there is no destruction and loss of the test sample as material evidence in the criminal proceedings.
  - the wide application of this method is due to high enough sensitivity, accuracy, speed, and for the holding complete analysis by the method of IR-spectroscopy, the expert must spend less time and a minimum of the consumable items.
  - the result of the analysis is understood for all participants in the process that satisfies the requirements, which are required for scientific research methods during forensic examinations.
  - the application of the IR-spectroscopy will give the opportunity significantly to reduce the time and cost of holding of examinations.

#### **4. The conditions of application of the method of IR-spectroscopy by the court expert**

The modern equipment provides the court expert with the widest possible possibilities for the analysis of all samples as objects of the expert research, however, qualitative analysis of samples is related to the quality of preliminary preparation of the sample. That is why the efforts of developers of devices for the IR-spectrometry and methodological support for working with them are aimed at minimizing the preparatory stage, providing the possibility of the holding of rapid analysis of the samples, which is especially relevant for use in the course of holding of operational and investigative measures and covert investigative (search) actions. The general rule of the

application the method of IR-spectroscopy is that any corrections during the study must be applied very carefully, always preserving the original spectrum.

Because of processing of samples, it is impossible to break the unique for each substance ratio of intensity of absorption bands and their form, care must be taken not to inadvertently destroy the absorption peaks that are inherent in the test substance. It is also necessary to take into account that all search algorithms are constructed in such a way that the factor of coincidence is influenced first of all by peaks of the greatest intensity and area, that's why, in the finding it is expedient to divide the spectrum under analysis into sub bands depending on the amplitude and width of the peaks, and then compare the obtained results (Ezevskaya and Bublikova, 2006; Tanasevich, 2012)

For the researcher and the procedural persons who involved the expert, the expected results from the process of the application of this method are that it will facilitate this.

In the case of improving the base of instruments, software, and the emergence of more high-precision IR-spectrometers, it is possible to use this method to explore new objects. The use of this method in the application of 'non-classical' for IR- Fourier spectroscopy of the far wave and near wave regions of the spectrum is promising, in addition, both in qualitative and quantitative analysis, in the study of samples of pharmaceutical products during the holding forensic, forensic pharmacological examinations, as well as for the research of petroleum products in soils, water, other environments and natural deposits during the implementation of the forensic environmental examination etc. (Rudniev *et al.*, 2013).

The research in the near wave region of the IR-spectrum will allow the use of this method for remote detection of particles of the explosive substance in the air, on the surface of the soil or on individual objects, which creates conditions for safe work of the specialist with the explosive objects during the inspection of the scene or the holding of expert examination. The application of quantitative analysis by the method of IR-spectroscopy will give opportunity significantly to reduce the time of the holding of the difficult examinations, and the provision of analysis of near and far wave areas will allow to more accurately determine the chemical composition of the studied objects, therefore it will reduce the number of probable conclusions and conclusions in the form of 'it is not possible to establish' in relation to the categorical conclusions of the expert.

## **5. The algorithm of application of the method of IR-spectroscopy**

The general conditions for the holding of structural analysis of any substances on their IR-spectra is the need of the receiving of the high-quality spectrograms, which accurately transmit the position and contour of the absorption bands, do not have distortions caused by incorrect choice of spectrum capture conditions and unreliable condition of the applied equipment.

The samples that are researched, may be in a liquid, solid, gaseous aggregate state. They can be organic or inorganic, however, it should be borne in mind that inorganic substances sometimes do not give the clear expressed spectra. Due to the fact that the physical state of the sample can strongly affect the IR-spectrum, in each case of the holding of research it is necessary to determine the hierarchy (the sequence) of methods, which will be used in the holding of research. The sequence of application of the methods of research is determined by the types of samples and methods of their preparation (Kolesnyk and Sapoletova, 2011; Tanasevich, 2012).

The application of the methodic in such sequence can be chosen for the liquid sample: 1) the solution; 2) the undiluted liquid in a thin cuvette, if the liquid is insoluble; 3) the liquid that is compressed between the salt plates, the so-called 'the liquid film', 'the crushed drop'.

Such a sequence is desirable to be used for the powders, bulk, and solid samples: 1) the solution; 2) suspension in the Vaseline oil; 3) the tablets with KBr.

## **6. The algorithm for holding of the research of samples of the liquid compounds**

The samples in the form of oil or other liquid are applied with a film on plates of transparent material (for example, KBr, NaCl). The thickness of the absorption layer is usually set from 0,005 to 0,1 mm.

The infrared spectra can be measured for the solutions. Since there are no solvents that are transparent to the whole part of the spectrum, the IR-spectra of the solutions are usually taken only for narrow zones. The measurements are performed in special hermetically sealed cuvettes, which have the form of plates that are fixed in a metal form. The influence of air, which may interfere with the holding of measurements, is eliminated by vacuum treatment of the device or purging it with the Nitrogen.

## **7. The algorithm for holding of the research of solid substance**

1. A sample of the test substance for analysis must be pre-dried without the use of high temperatures and prepared in an inert atmosphere in an amount of from 0,5 to 3 mg.
2. The exemption of the substance and preparation of a sample of the test for research is carried out in a special box.
3. The preparation of solid samples for the registration of their infrared spectra is carried out in two ways.
  - A) The suspension method is the grinding of the sample to a micronized state (the particle size 2-7 mkm) and the preparation of a suspension in an immersion liquid with a refractive index that is close to the sample. In addition, as the matrix, Vaseline oil that is fluorinated or a chlorinated oil is usually used. The resulting translucent paste is applied with a spatula on a window that is made of optical material in the form of a thin uniform film.
  - B) The compression of tablets with alkali metal halides can be considered as the main and universal way of the preparation of tests. It consists in thorough mixing in a mortar of the crushed sample with pre-dried from moisture powder KBr (the potassium bromide) and the next pressing the resulting mixture in a press mold. The result is a clear or semi-transparent tablet as a sample of the test for the research. The note: drying of potassium bromide should be carried out at a temperature of  $\approx 600^{\circ}$  C for at least 6 hours and store it in an inert atmosphere. The method of compression of tablets with KBr and researched samples should be carried out for those samples that are insoluble in conventional solvents, are amorphous or have a stable crystalline structure and do not contain ions that are exchangeable.

## **8. The algorithm for holding of the research of gases**

In most cases, there are no problems with the preparation of gaseous samples of the substance. However, it should be noted in mind that for aggressive gases and liquid vapors it is necessary to use cuvettes that are made of special inert materials, as other materials can contaminate the researched samples.

The pressure in the cuvettes is brought to atmospheric by the dry nitrogen, which increases the sensitivity to the number of components and

allows holding accurate quantitative measurements. In several cases, for example, for the study of a polluted atmosphere, etc., high sensitivity is important and then use gas cuvettes with a large length of the optical way. The residual amounts of harmful, toxic fumes, gaseous explosive mixtures are adsorbed on the wood charcoal in adsorption tubes and are treated with a solvent for identification by the IR-spectrum.

These are the main possibilities and the most common in the practice of forensic examination are cases of using the method of IR-spectroscopy for the research of individual objects during the committing of criminal proceedings for the collection by the investigator, the prosecutor, the side of defense and the evaluation of collected evidence by the court.

### **Conclusions**

The innovations as the introduction of the new ideas, of new methodic in the forensic research, the introduction them into the practice of the work of expert institutions and departments is capable of not only improve the level of scientific and technical support of expert and forensic practice, but also contributes to improves the quality of expert research, raises the level of confidence in the correctness and validity of the conclusions that has been made by the expert. The ample opportunities for the research of many objects of forensic examination has the use of the method of the IR-spectrometry as a modern and advanced method of physical researches of various traces, substances, objects as objects of organic and inorganic origin, even in the very small quantities. The knowledge of the investigator and the court of their nature, essence and composition often becomes an important element of evidence in the criminal proceedings. Not only experts as specialists, but also investigators, prosecutors, judges, lawyers as procedural persons should know about the possibilities and procedure of the using such a method, by whose hands justice is administered and on which the observance of the rights of participants in the proceedings during its committing.

### **Bibliographic References**

- BARANNIKOVA, Iryna. 2017. "A method of IR-Fourier is spectrosopes in judicial examination and prospects of his use" In: Theory and practice of judicial examination. Vol. 12, No. 1, pp. 85-91.
- EXAMINATIONS IN THE LEGAL PROCEEDING OF UKRAINE. 2015. Scientific-train manual. Kyiv, Ukraine.

- EZEVSKAYA, Tetiana; BUBLIKOV, Aleksandr. 2006. "Preparation of tests and methods of research of different objects on IR-Fourier spectrometer with prefixes, including an IR-microscope and MNPVO, during the lead through of criminalistics examinations" In: *Expert-criminalist*. Vol. 06, No. 12, pp. 114-122.
- HORA, Iryna. 2016. *Judicial examinations in the field of medicine, pharmaceuticals and bioethics*. In the book: *Persons: medicine, pharmaceuticals, bioethics: scientific monograph*. Kiev, Ukraine.
- KOLESNYK, Iryna; SAPOLETOVA, Nina. 2011. *Infra-red spectroscopy. Methodical development*. Moscow, Russia.
- KOLESNYK, Valeriy; HORA, Iryna. 2017. "Criminalistics is in counteraction the illegal use of explosive devices" In: *Shooting iron and to the turn of drugs*. Kyiv, Ukraine.
- LITVIN, Bohdan. 2009. *Physical methods of research of organic matters: a train aid*. Ivano-Francovsk. Odesa, Ukraine.
- MAKSIUTINA, Nina; KAGAN, Fedir; KIRICHENKO, Lyudmyla; MITCHENKO, Fedir. 1984. *Methods of analysis of medications*. Zdorov'ya. Kyiv, Ukraine.
- RUDNIEV, Vasyl; KLIMCHUK, Aleksandr; PROKOPENKO, Aleksei; KARNOZHITSKYI, Pavlo. 2013. "Individualizing signs of products from oil as aggregate of physical and chemical properties and component composition" In: *Theory and practice of judicial examination*. No. 13, pp. 295-300.
- TARASEVICH, Borys. 2012. *Bases IR spectroscopes with transformation of Fourier. Preparation of tests in IR spectroscopes*. Moscow, Russia.
- TARUTINA, Liudmyla; POZDNIAKOVA, Faina. 1986. *Spectrology of polymers*. Chemistry. Leningrad, Russia.



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