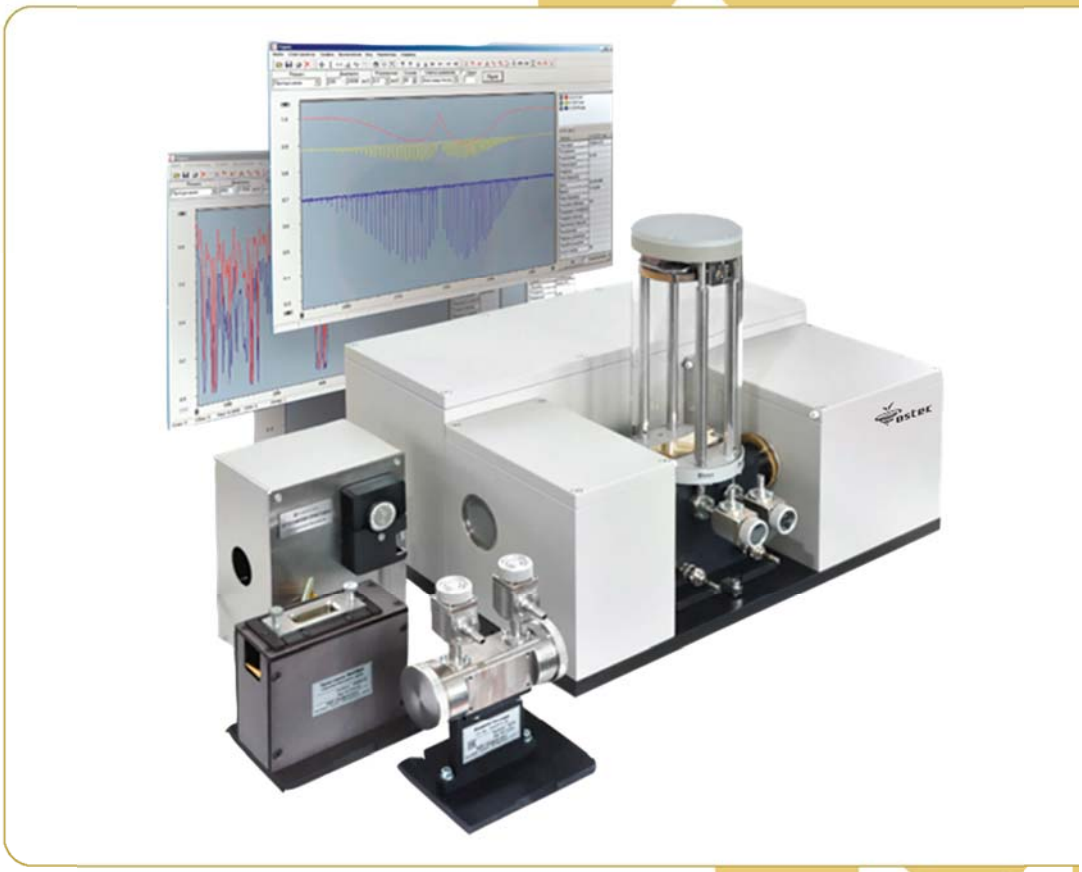
ostec
corporate group

future's
in the making

IROS P series

Industrial FTIR Spectrometers



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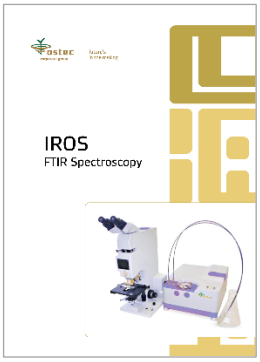
Our mission is to be a company that finds, protects and develops cutting-edge ideas to create new products for technology progress. That is why the symbol of our company is a growing sprout.

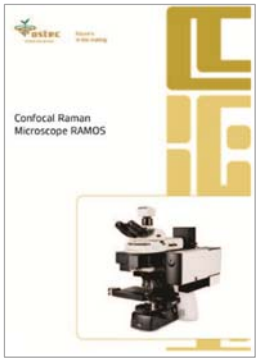
Ostec select the best innovative technologies and instruments, modify by corporate engineering and provide complete solutions on international market by Ostec Company Group.

We offer to our clients: the most suitable equipment to meet customer's requirements, deep knowledge of customer's applications, qualified and reliable maintenance support.

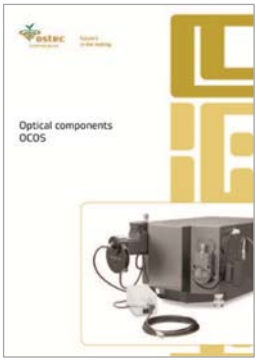
Our other products:



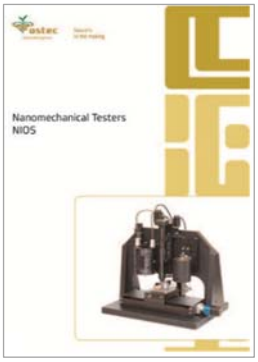
IROS
FTIR Spectroscopy



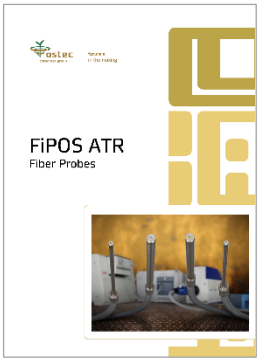
RAMOS
Confocal Raman Microscopes



OCOS
optical components

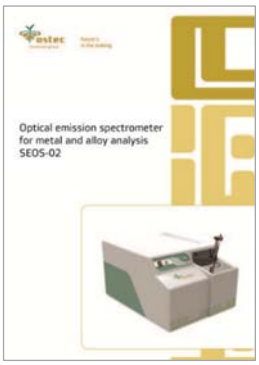


NIOS
Nanomechanical Testers

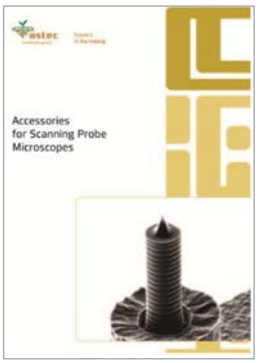


FiPOS ATR
fiber probes

AVOS
vibration control solutions



SEOS 02
optical emission spectrometer



Accessories for Scanning Probe Microscopy

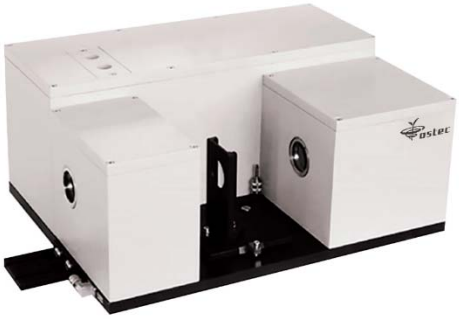
LIOS 500N
laser elemental analyzer

OMOS M series
Analytical Metallographic Systems

Ostec offers instruments with unmatched performance

- More than 25 years of FTIR spectrometers development and production under INFRASPEC brand
- The best price-performance ratio
- Wide range of accessories
- Great experience in non-standard and customized systems design to meet customers' requirements
- Collaborative developments with leading research institutes
- Unique development and production of spectrometer components

Turn-key solutions for dedicated technological issues



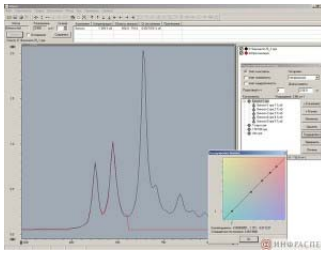
IROS P01/P02/P03/P11

+

Cells

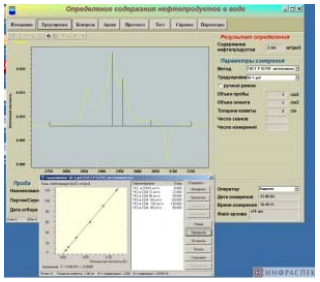
Extension modules

+



Main control software

&

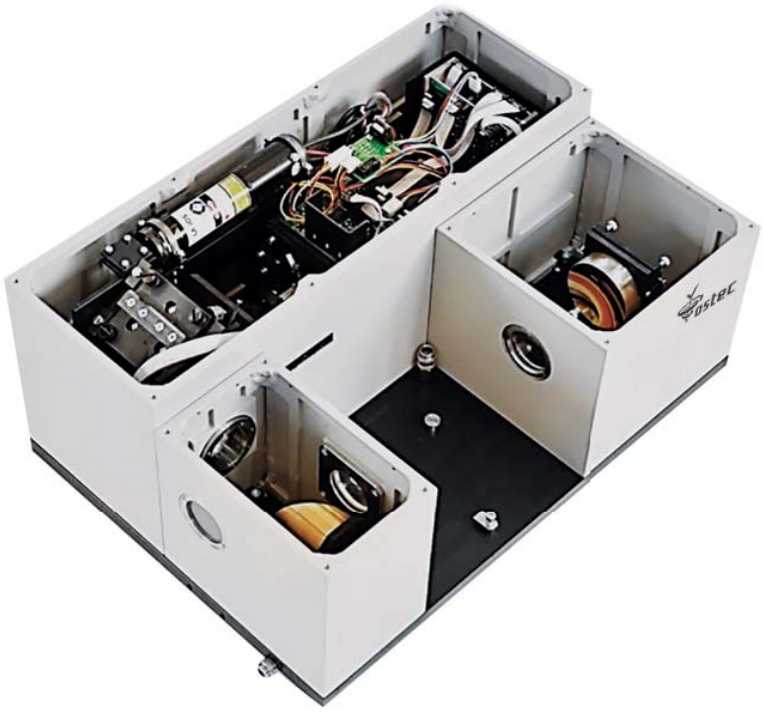


Additional software modules

Industry application fields:

- Chemistry
- Polymer chemistry
- Petrochemistry
- Petroleum and gas production
- Coal industry
- Environmental Control
- Food and perfume industry
- Compound feed industry
- Medicine
- Emergency control
- Forensics
- Electronics industry
- Optical manufacturing
- Electric Power
- Gas analysis
- Textile industry
- Diamonds

FTIR spectrometers based on Michelson interferometer



Michelson interferometer with self-compensation, no dynamic adjustment needed

Radiation source – nichrome-ceramics / halogen lamp

KBr/Ge/CaF_2/Ge optical windows and beamsplitter with moisture-proof coating

Pyroelectric DLaTGS detector / InGaAs or Si photodiodes

Internal calibration – He-Ne laser.

Purge system – CDA or nitrogen for CO_2 and H_2O vapour noise minimization

Recording system – 24-bit A/D converter with amplifiers and anti-noise filters.

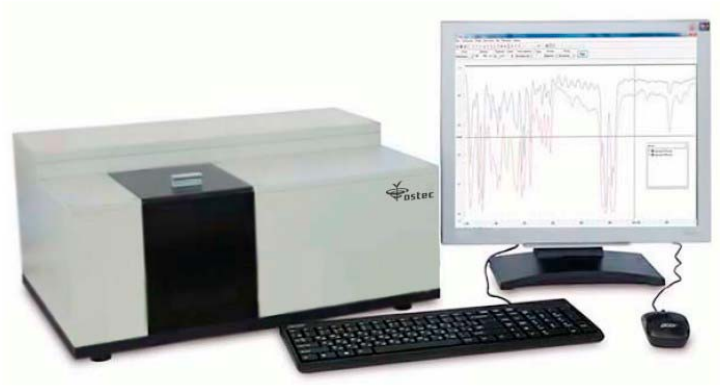
Main characteristics

- Spectrometer's product range with resolution up to 0.12 cm^{-1}
- High sensitivity, rapid response
- Automated measurements, easy to use
- Wide range of accessories
- Application software for dedicated tasks

IROS P series Multipurpose Industrial FTIR Spectrometers

Multipurpose industrial IR Fourier spectrometers **IROS P** series are designed for routine analytical measurements in the mid-IR and near-IR region of the spectrum, in particular, qualitative and quantitative analysis of samples of organic and inorganic substances in gaseous, liquid and solid state, including films and powders.

IROS P series FTIR spectrometers are based on the Michelson self-compensating interferometer which does not require dynamic adjustment, and have the ability to install in the cell compartment a variety of gas and liquid cells, optical attached modules and accessories for liquid, solid and gaseous samples.



IROS P01 & IROS P02

Multi-purpose **IROS P01/02** lab FTIR spectrometers are designed for routine measurements and scientific research in the mid-IR spectrum.

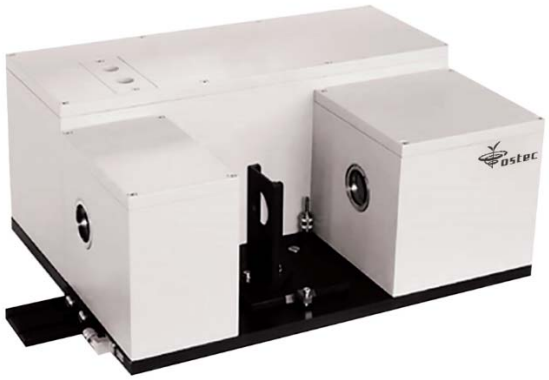
IROS P01/02 are basic models for scientific, testing and analytical laboratories. These spectrometers have high signal-to-noise ratio, spectral resolution 1.0/0.5 cm^{-1}, large cell compartment.

These spectrometers are equipped with a dry air or nitrogen blowing system to minimize spectral interference from water vapor and carbon dioxide and have a waterproof coating of optical windows and beamsplitter.

IROS P03

IR Fourier Spectrometer **IROS P03** is laboratory tool for studies requiring increased spectral resolution, including for qualitative and quantitative analysis of gases.

The device operates in the middle IR spectral area, has an optical port for inputting radiation from an external source, is equipped with an inert gas blowing system.



IROS P03 FTIR spectrometer can be successfully used as a tool for measuring the fine structure of oscillatory and rotational spectra of molecules of atmospheric and polluting gases.

It has two registration channels, one of which provides operation from its own radiation source, and the other allows to measure the radiation, which is entered through an optical port from an external source.

Various detectors can be used to record spectra, including Si bolometer with liquid nitrogen cooling, which are switched automatically. With the help of this spectrometer, it is possible to perform analysis of atmospheric contaminants both by sampling in a gas duct and remotely using the trace method of detection.

IROS P11

IROS P11 is a laboratory Fourier spectrometer designed for quantitative and qualitative studies in the near-IR range and has the next advantages: high informativity of the obtained data, speed and accuracy of measurements, does not require preliminary preparation of samples and special training of personnel.

IROS P11 uses changeable detectors: InGaAs for spectral range of 9 000 – 4 000 cm^{-1} and Si for spectral range of 12 500 – 8 500 cm^{-1}.

Main application fields for **IROS P11** are: chemical, polymer, textile, food and compound feed industries products, identification and quantity analysis.

IROS P series technical specification

	IROS P01	IROS P02	IROS P03	IROS P11
Spectral range, cm^{-1}	7 800 – 370			12 500 – 3 700
Spectral resolution, cm^{-1}	1.0	0.5	0.12	2.0
Signal-to-noise ratio, RMS	> 60 000 (time 1 min, range 2 200 – 2 100 cm^{-1}, res. 4 cm^{-1})			> 60 000 (time 1 min, range 4 600 – 4 500 cm^{-1}, res. 4 cm^{-1})
Complete spectrum obtaining minimum time, s	< 1			
Beamsplitter	KBr with Ge-based coating		KBr with multi-layer Ge-based coating	CaF_2 with multi-layer Ge-based coating
Radiation source	High temperature ceramic metal		High temperature ceramic metal or external	Halogen lamp
Detectors	Pyroelectric DLaTGS detector		DLaTGS, cooled PbSe photo resistance	InGaAs, Si photodiodes
Cell compartment dimensions, mm	200x190x170			150x190x170
Spectrometer dimensions, cm	520x370x250		540x490x250	520x370x250
Weight, kg	30		36	28

Software

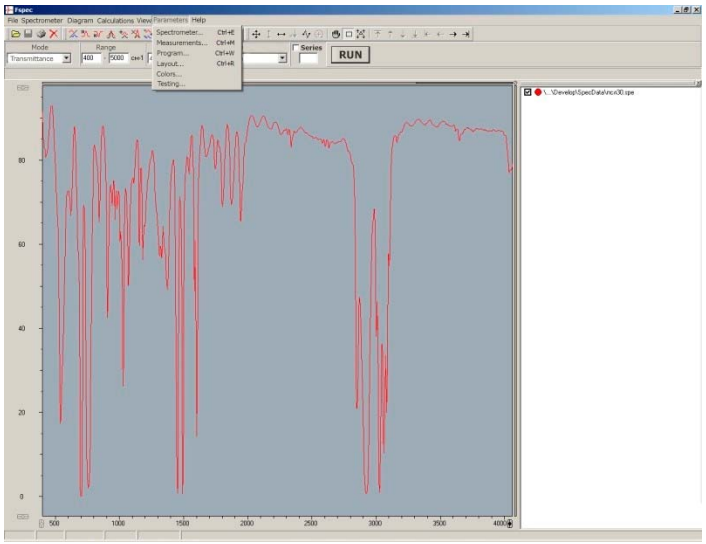
Device control, self-diagnosis, recording, analysis and spectra processing operations are automated and are performed using PFSpec basic software developed by Ostec company specialists for Windows XP/Vista/7/8/10 environment.

The control software has user-friendly interface, allows to create own libraries of spectra, and also to use standard libraries and works with spectra in formats *.spe, *.spc, *.dx, *.asc. Processing of spectra includes basic mathematical operations and transformations, search of spectral lines and definition of their parameters.

To work according to standard methods: GOST, ASTM, EN, SEMI or to perform measurements in the analyzer mode, additional software modules with "push-button" control of the device, built-in measurement algorithms and graduations are integrated to PFSpec platform.

Software features:

- Self-diagnosis of the main components of the analyzer;
- Selection of operating parameters and measurement modes;
- Registration of spectral data (multiple ATR spectra) for analyzed samples;
- Measurement results and component concentrations displaying;
- Measurement protocols printing;
- Saving an archive of spectral data, measurement protocols and log file with self-diagnosis results.



Software modules

Module	Description
PFSpec	**IROS P** spectrometers operation control, basic data processing functions
PASpec	Quantitative analysis of IR spectra, CLS method
POilNH3	Determination of oil in liquid ammonia from IR spectra (*ISO 7106-88*)
PSemiSpec	Determination of interstitial oxygen in silicon (*ASTM F1188*), substitutional carbon in silicon (*ASTM F1391*), epitaxial layer thickness for silicon structures (*ASTM F95*), radial interstitial oxygen variation in silicon wafers (*SEMI MF951*), boron and/or phosphorus in *BPSS/PSS*, silicon epitaxial layer thickness for SOS structures
PLaprol	Determination of oxoethyl groups in polyether from IR spectra
PRubbIR	Determination of ethylene units in EPM copolymers and EPDM terpolymers *(ASTM D3900*), and ENB or DCPD in EPDM terpolymers (*ASTM D6047*)
Spectra library	Identification of substances and search for structural analogues of unknown compounds by their IR spectra. The database includes 25 libraries (polymers, medicines, drugs, toxic substances, dyes, toxic chemicals, plasticizers, lubricants, oil products, surfactants, adhesives, minerals, food additives, etc.) and contains a total of over 70,000 full spectra.

IROS P series Extension Modules

IROS P series FTIR spectrometer can be equipped with large number of extension modules. It makes possible to use **IROS P** series spectrometers for different common and specific applications.

Quartz cells

Demountable cells

Fixed optical length gas cell

Multi-pass gas cells

Thermostable gas cell

Specular reflection modules

Diffuse reflection module

HATR module

Autosampler for gasoline analysis

Modules for wafer analysis

Near-IR module

Quartz liquid cells

Quartz cells are designed for testing liquid samples and have a fixed optical path length. They are used, in particular, to determine the mass concentration of petroleum products in water and oil in liquid ammonia by infrared absorption spectra (control area 2925 cm^{-1}).

The cells are made of optic quartz glass of KV grade.

Quartz cells are delivered with a cover from fluoroplastic.

The length of the optical path: 1, 3, 5, 10, 20, 30, 40, 50 mm.

Demountable gas cells

Ostec offers two types of demountable gas cells:

1. Thin layer cell for study liquids placed between two windows as a thin layer, determined by the brass gasket. Samples can be analyzed pure or diluted with an appropriate solvent.
   Brass gasket kit: 0.1; 0.2; 0.3; 0.5; 0.8.
   Window material: KBr, CaF_2, ZnSe.
2. The cell for study of liquid samples with weak absorption and suspensions in vaseline oil prepared from solid samples.
   2 cylindrical PTFE inserts: 10 and 20 mm.
   Window material: KBr, CaF_2, ZnSe.
   Window size: Ø 40 mm.

Gas cell with a fixed optical length

The cell is designed to determine impurities in gases with a threshold of < 1%.

Flow mode or gas filling after vacuuming.

Stainless steel casing, two bellows valves.

Optical length – 100 mm.

Windows Ø40 mm, KBr with waterproof coating or CaF_2.

Multi-pass gas cells

Multi-pass gas cell is designed for the determination of impurities in gases with a threshold of < 0.1 ppm.

Optical length: 0.8 – 40.56 m

Step: 0.8 or 3.12 m.

Window material: KBr with waterproof coating or CaF_2.

Gas thermostatable cell

The cell has 100 mm fixed optical length and is designed to investigate gases, gas mixtures and vapors in flow or static mode by IR transmission spectroscopy with the ability to maintain or change the temperature of the sample.

The cell is installed in the spectrometer and connected to the source of the investigated gas samples using a gas transfer tube.

Exchangeable optical windows: ZnSe and KBr.

The possibility of heating up to 250ºC. The built-in heaters and the cell temperature sensor are controlled by the temperature controller (included in the scope of delivery).

The material of the cell housing is stainless steel.

Specular reflection modules

Specular reflection modules are designed for routine measurements of solid samples and coatings with thickness range from nanometers to microns: for identification of coatings and determining their thickness.

Specular reflection, obtained for relatively thin films on a reflective substrate and measured for an angle of incidence close to normal, is usually highly accurate and gives spectra very similar to transmission spectra.

Features:

- Reflected radiation measurement for close to normal angle of incidence;
- Fixed angles of incidence – 10º, 30º, 45º, 80º;
- Easy to install in the device;
- No sample preparation;
- Convenient sample location.

Diffuse reflection module

The module is designed to measure the diffuse reflection spectra of scattering surfaces and dispersed samples in the mid- and near-IR spectral range.

Diffuse reflection spectra of the investigated samples are measured against a suitable non-absorbing comparison sample. Measurement conditions tend to be chosen in such a way as to minimize the mirror component of the reflection. In most cases, this is achieved by mixing the test substance with a powder of an unabsorbing material such as KBr, which acts as an unabsorbing matrix. This eliminates the need for laborious sample preparation.

Advantages of the method:

- Minimal or no sample preparation requirements;
- Ability to investigate highly absorbent materials;
- Possibility to study irregular surfaces or coatings, including polymeric ones;
- Possibility of obtaining spectra in a wide range of concentrations of the studied substance.

Horizontal-type multiple ATR module

Horizontal-type multiple ATR (HATR) module is designed to investigate the chemical composition of liquid media, fine nonabrasive powders and polymer films. It allows to simplify sample preparation and can be used for express quality control of production.

HATR module successfully replaces the cuvettes and devices used for the analysis of liquid, semi-liquid and solid substances and is suitable for both qualitative and quantitative analysis. Sample preparation is reduced to placing the sample on the prism crystal.

Features:

- Up to 7 internal reflections for maximum sensitivity;
- ZnSe prism crystal as standard. Ge or Si prizms are possible. The effective thickness of the absorbing layer depending on the material and the prism parameters can be selected in the range of 1-50 μm;
- High accuracy in reproducing the effective thickness of the absorbing layer;
- Spectrum acquisition time at standard resolution and photometric accuracy does not exceed 1-2 min;
- The clamping device allows powders and films to be pressed to the prism surface.

Autosampler module for gasoline analysis

The autosampler module is designed for installation in the universal IR Fourier Spectrometer **IROS P** for gasoline analysis, which includes:

- Determination of benzene concentration according to *GOST R 51930 (ASTM D4053, EN 238)*;
- Determination of oxygenate concentration in accordance with *GOST R 52256 (ASTM D 5845)*.

The autosampler module includes a flow liquid cell. Sample taking and solvent washing of the cuvette is performed automatically by means of built-in peristaltic pump under software control. The sample volume does not exceed 10 ml.

Modules for wafer analysis

The modules are designed to control parameters of semiconductor wafers up to 200 mm in diameter in the transmission or reflection modes by a high-sensitivity non-contact method at operator defined points.

Main measured parameters:

- Concentration of interbody oxygen (plate thickness 0,4-2,0 mm) within (5×10^{15}-2×10^{18}) $\pm5\times10^{15}$ cm^{-3} (*SEMI MF1188*);
- Replacement carbon concentration (plate thickness 0.4-2.0 mm) within (5×10^{15}-2×10^{18}) $\pm5\times10^{15}$ cm^{-3} (*SEMI MF1188*): (10^{16}-5×10^{17}) $\pm10^{16}$ cm^{-3} (*SEMI MF1391*);
- Radial oxygen inhomogeneity in silicon wafers (*SEMI MF951*);
- Thickness of epitaxial layers of silicon structures such as n-n+ and p-p+ within (0.5-10.0) ±0.1 μm, (10-200) ±1% μm (*SEMI MF95*);
- Thickness of epitaxial silicon layers in NNS structures within the range of (0.1-10.0) ±1% μm;
- Concentration of phosphorus in FSS layers and boron/phosphorus in BFSS layers within (1-10) ±0.2% weight.

Near-IR module

The module is designed to measure the absorption spectra of samples in the near infrared region of the spectrum in the range of 4 000 – 12 500 cm^{-1} with **IROS P11** FTIR spectrometer.

Using near-IR field it is possible to perform identification and quantitative analysis of pharmaceuticals, products of chemical, polymer, textile, food, agricultural and other industries.

The sample is placed in a quartz cell, which is mounted in a retractable cell holder. The cell holder is fixed in three positions in the attachment to analyze the sample at three different points. This increases the measurement accuracy of heterogeneous samples.

IROS P01 based FTIR Spectrometers for Fuel Analysis

IROS P01 FTIR spectrometer combined with autosampler extension module and PFSpec + PAPetro software modules are used for on-line fuel quality control: oxygenates and benzol detection in petrol and aviation benzene.

IROS PAPetro software features

- Petrol probe injection through autosampler with integrated peristaltic pump
- Automatic basic IR spectrum detection using comparison sample in a separate cell
- Flow-cell sample and solvent rinse
- IR spectra registration and mathematical treatment
- Report preparation and data backup
- Analysis results print output

Analyzer root principle

- Analyzed probe spectrum comparison to the calibration mixture (of known oxygenates and benzene content in petrol) spectrum
- Rapid analysis: one probe < 2 min
- Analyzer is factory calibrated in accordance with *ASTM E1655*
- For calibration verification samples prepared in accordance with *ASTM D4307* are used

Oxygenates measurement range and accuracy in accordance with ASTM D5845

Analyte	Measurement range, w/w, %	Standard deviation, %
MTBE	0.1 – 20	0.9
ETBE	0.1 – 20	0.75
TAME	0.1 – 20	1.2
DIPE	0.1 – 20	0.6
Methanol	0.1 – 6.0	0.25
Ethanol	0.1 – 11	0.4
TBA	0.1 – 14	0.55
Propanol	0.1 – 10	0.5
IPA	0.1 – 10	0.5
MMA	0.1 – 5.0	0.3

Oxygenates and benzol detection in petrol

IR spectra analysis is performed via multi-dimensional least-squares method of PAPetro software.

IROS P01 IR Spectrometer for Electrical Insulating Mineral Oil Monitoring

Combination of **IROS P01** FTIR spectrometer, demountable liquid cell (with KBr window) and PASpec software allows to implement consistent procedure for identification and quantitative assay of the antioxidant in insulating oil concerning *ASTM D2668-07(2013) "Mineral insulating oils. Detection and determination of specified additives"*.

Liquid cell should be chosen depending on a task and probe properties. It can be demountable or one-piece, with proper optical path length and window material clear in the needed spectral range.

Liquid cell is filled with a probe and is put inside the spectrometer cell compartment.

PASpec software is installed into basic PFSpec software and include following functions:

- Generation of a calibrating model;
- Qualitative and quantitative assays;
- Generation of data archive;
- Edit printout of measurement reports.

PASpec software has a built-in editor of macro expansion instructions for automation of measurements and a report editor.

Basic analysis stages:

1. Samples shall be collected as per *ASTM D 923 "Standard Practice for Sampling Electrical Insulating Liquids"*;
2. Registration of absorption spectrum of the base oil free of the inhibitor (A_0);
3. Registration of absorption spectrum of the sample (A);
4. Quantitative analysis of IR spectra, CLS method Absorbance = $A - A_0$;
5. Identification of the inhibitor type on the basis of absorption features: DBPC – 860 cm^{-1}, DBP – 750 cm^{-1};
6. Region of spectrum for quantitative assay 3 675 – 3 625 cm^{-1}, with calculation of % wt. of the inhibitor.

An important feature of insulating oils used in power equipment in the course of the long-term operation is their oxidation stability. Phenolic antioxidants of butylated hydroxytoluene (BHT) type (2,6 di-tretbutyl-para-cresol, DBPC) are lipophilic organic compounds, chemically a derivative of phenol, that is useful for its antioxidant properties. Recommended content of additive in oil as per *IEEC 60296:2003 "Fluids for electrotechnical applications. Unused mineral insulating oils for transformers and switchgear. Specifications"* varies from 0.25 to 0.4 % wt.

Features

- Automation of measurements including start testing and self-diagnostics
- Automatic calculation of the oil parameters on the basis of the calibrating model
- Interactive "button" control interface

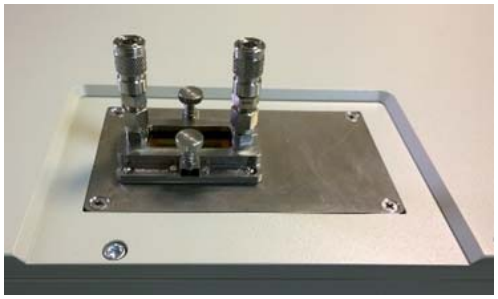
IROS P01F FTIR Fluid Analyzer with HATR Flow-Cell

IROS P01F is the system with a multi-reflective ATR horizontal measuring flow cell based on **IROS P01** classic IR Fourier spectrometer. The optical design does not require alignment. The system block is leaktight, which prevents the entry of water vapor and other substances from the surrounding atmosphere. The flow cell is removable, which allows quick cleaning and maintenance. The system may include both a crystal mounted at the surface level and a crystal recessed into the housing.

The HATR crystal is integrated into the upper cover of the device. The design is leaktight, which simplifies the maintenance of the flow cell. The cover with the crystal is also removable, which makes it easy to carry out maintenance of the cell, replacing the crystal if necessary.

Features

- Available with various crystals (Ge, ZnSe, etc.)
- Leaktight design
- Easy to maintain
- Removable cell with the ability to clean and replace the crystal



The flow analysis of various liquid substances is a crucial task in many industries. Carrying out automatic screening in the flow cell of an IR-Fourier spectrometer integrated into the production line allows to obtain valuable data on the processes occurring in real time, without delays which cannot be avoided during the analysis by an autonomous method with sampling. This allows you to minimize risks and reduce time costs to obtain the necessary results.

Specification

Spectral range, cm^{-1}	5 500 – 600 (with Ge) 7 800 – 550 (with ZnSe)
Spectral resolution, cm^{-1}	1,0 (0,5 on request)
Detectors	$LiTaO_3$ (DLaTGS on request)
HATR module	Ge, 45º (ZnSe and other on request)
Power supply	220 V, 50 Hz
Consumed power (without PC), W	60
Weight, kg	32
Dimensions, mm	290x490x250

Sampling technological solutions with shut-off ball valves and a regulating needle valve

Both the sampling device and the analyzer flow cell use a single interface – quick disconnect couplings (QDC) with double-sided locking. This interface makes it easy to integrate the analyzer into the production line.

It is also possible to put a sample for analysis into a cell using a syringe through a nozzle.

IROS P03 based FTIR Spectrometer for Atmospheric Composition Analysis

IROS P03 FTIR spectrometer combined with gas cell and PFSpec + PASpec software modules are used for atmospheric composition analysis.

Climate active gases detection in the air: CH_4, CO, CO_2, H_2O, N_2O

Sensitivity limit < 0.1 ppm

IROS P03 spectrometer-based gas analyzer has 2 registration channels:

- Multi-pass gas cell, optical path length of 40 m, surface air quantity analysis with discrete sample collection;
- Optical port for solar radiation (radiometric unit), gas component concentration detection in higher atmospheric layers.

This configuration with other gas cells allows to detect and analyze multi-component gas mixtures, pure gases, organic solvent vapors, etc.

Depending on a gas mixture needed component concentration simple or multi-pass cells are being used (optical path is from 100 mm to 40 m).

If there is a risk of vapor condensation, temperature-controlled cell and heated up to 250 ºC gas line is being used.

For air (remote sensing) track measurements are being conducted (radiometric unit for spectrometer).

Detection limits (3σ)*, ppm	
CO_2	1.0
CH_4	0.02
CO	0.05
N_2O	0.004

** – multi-pass gas cell, 40 m*

IROS P01W FTIR Semiconductor Wafer Analyzer

IROS P01W FTIR spectrometer is a dedicated silicon wafer analyzer with a dual detector design and fully computer-controlled sample table. It is designed for automated testing of silicon wafer parameters according to a profiling pattern given by the operator. Wafer sizes up to 200 mm can be accommodated.

IROS P01W is based on classic **IROS P01** FTIR spectrometer with Michelson interferometer scheme.

FTIR spectroscopy is a powerful tool for non-destructive characterization of semiconductor wafers and structures. This is confirmed by a number of standards, recognized worldwide, such as *SEMI MF1188* and *SEMI MF1391*, introducing test methods for interstitial oxygen and substitutional carbon content in silicon, or *SEMI MF95* describing test method for thickness of epitaxial layers of n-n+ or p-p+ type silicon structures. Also, determination of phosphorous and/or boron concentrations in PSG/BPSG layers is possible, or SOI structures and dielectric films characterization.

Characterized parameters

- Interstitial oxygen concentration in silicon (wafer thickness 0.4–2 mm): ($5x10^{15}$–$2x10^{18}$) ±$5x10^{15}$ cm^{-3} (*SEMI MF1188*)
- Substitution carbon concentration in silicon (wafer thickness 0.4–2 mm): (10^{16}–$5x10^{17}$) ±10^{16} cm^{-3} (*SEMI MF1391*)
- Radial interstitial oxygen variation in silicon wafers (*SEMI MF951*)
- Thickness of epitaxial layers for silicon n-n+ and p-p+ structures: (0.5–10) ±0.1 mm, (10–200) ±1% mm (*SEMI MF95*)
- Thickness of silicon epitaxial layers for SOS structures: (0.1–10) ±1% mm
- Boron and/or phosphorus concentration in BPSG/PSG on silicon: (1–10) ±0.2 wt. %

Features

- High efficiency. Measurement time for routine spectral resolution and photometric accuracy parameters does not exceed 15-20 sec. It permits not only random but also complete process testing of product wafers and structures. Assessment of the wafer non-uniformity is made possible for by the use of profiling of the material parameters
- Analysis reliability. Identification and analyses are based on the whole spectrum simulation utilizing reference spectral library, and PLS optimization procedures
- Non-destructive measurements. IR optical measurements are by nature non-contact and non-contaminating
- Automated testing process. All the testing operations covering spectra acquisition, analysis, sample table transport, are computer controlled. Profiling options include standard 1-, 5-, and 9-point star configurations, as well as operator-programmed patterns. Results of the wafer testing are automatically logged into a database
- Easy installation and service. Due to advanced design, spectrometer does not require cooling water or pressurized air

Specification

Spectral range, cm^{-1}	7 800 – 400
Spectral resolution, cm^{-1}	1,0
IR beam diameter on the wafer, mm	6
Maximum wafer diameter, mm	200
Table positioning accuracy, mm	0,5
Basic measurement time at one point, sec	20
Beam splitter	KBr with Ge-based coating
Emitting source	High temperature ceramic-metal
Detector	$LiTaO_3$ pyroelectric detector
Dimensions, mm	670x650x250
Weight, kg	37

Industry Standards available for IROS P series Spectrometers

Chemical

- Determination of oil in liquid ammonia, *GOST 28326.3-89 (ISO 7106-88) "Ammonia liquid technical. Determination of oil mass concentration by infrared spectrometry"*
- Qualitative classification of surfactants, *ASTM D2357-11 "Qualitative classification of surfactants by infrared absorption spectra"*
- Determination of acetic acid content in cellulose acetic acid esters, *TU 6-55-16-88 "Cellulose acetic acid esters. Method for determination of bound acetic acid content"*

Polymer chemistry

- Identification of rubbers, rubber compounds and vulcanizates, *GOST 28665-90 (ISO 4650-84) "Rubber. Identification. Method of infrared spectrometry"*
- Identification of raw rubbers and their vulcanized and non-vulcanized blends, *ASTM D3677-10e1 "Standard Test Method for Rubber – Identification by Infrared Spectrometry"*
- Determination of components for the synthesis of rubbers, *ASTM D2702-05(2011) "Standard methodology for the determination of chemical products for the synthesis of rubbers by infrared absorption spectra"*
- Determination of ethylene content in EPM and EPDM, A*STM D3900-05a(2010) "Standard Test Methods for Rubber. Determination of Ethylene in Ethylene-Propylene Copolymers (EPM) and Three-layer Ethylene-Propylene-Diene Polymers (EPDM) by infrared spectroscopy"*
- Determination of ENB and DCPD content in ethylene propylene diene rubbers, *ASTM D6047-99(2009) "Standard Test Methods for Rubber – Determination of 5-ethyldenorbornene (ENB) or dicyclopentadiene (DCPD) in Ethylene Propylene Diene Terpolymers (EPDM)"*
- Determination of residual unsaturated hydrogenated nitrile rubber, *ASTM D5670-95(2009) "Method for the determination of residual unsaturated in hydrogenated nitrile rubber (HNBR) using infrared spectrometry", ISO 14558:2000 "Rubber. Determination of residual unsaturated hydrogenated nitrile rubber (HNBR) by infrared spectroscopy"*
- Determination of Butadiene Rubber Microstructure, *ISO 12965:2000/Cor 1:2006 "Butadiene rubber. Determination of microstructure by infrared spectrometry"*
- Determination of the hydroxyl number for polyols by NIR method, *ASTM D6342-12 "Polyurethane Raw Material: Method for Determining Hydroxyl Number for Polyols by Near Infrared Spectrometry"*
- Determination of toluoldiisocyanate content in raw materials, *ASTM D4660-12 "Polyurethane Feedstock: Method for Determining Toluoldiisocyanate Isomer Content"*
- Determination of methyl groups in polyethylene, *ASTM D2238-92(2012) e1 "Method for Determining Methyl Group Absorption in PE by IR Band 1378 cm^{-1}"*
- Determination of unsaturated vinylidene, *ASTM D3124-98(2011) "Method for the determination of unsaturated vinylidene in polyethylene using infrared spectrometry"*
- Determination of vinyl and trans-saturation in polyethylene, *ASTM D6248-98(2012)e1 "Method for the determination of vinyl and trans-saturated polyethylene by infrared spectrometry"*
- Determination of structural characteristics of polyolefins, *ASTM D 5576-00(2013) "Method for Determining Structural Characteristics in Polyolefins and Polyolefin Copolymers using IR Fourier Spectrometry"*

- Quantitative determination of polypropylene and LDPE mixture composition, *ASTM D7399-08 "Standard method for determining the quantity of polypropylene (PP) in a mixture of polypropylene (PP) and low-density polyethylene (LDPE) using infrared spectrophotometer (IR Fourier)"*
- Determination of the crystallinity of polyether ether ketone, *ASTM F2778-09 "Standard Test Method for Measuring Polyether ether ketone (PEEK) Polymer Crystallinity Percentage by Infrared Fourier Spectroscopy Mirroring Method"*
- Determination of ethylacrylate in ethylene ethylacrylate copolymers, *ASTM D3594-93(2013) "Method for determination of ethylacrylate in ethylene ethylacrylate copolymers"*
- Determination of vinyl acetate content in EVA copolymers, *ASTM D5594-98(2012) "Method for Determining Vinyl Acetate Content in Ethylene Vinyl Acetate Copolymers Using IR Fourier Spectrometry"*
- PVC Component Composition Analysis, *ASTM D2124-99(2011) "Method for the Analysis of Component Composition in Polyvinylchloride Compounds Using IR Spectrometry"*
- Determination of the content of hydroxyl groups, *GOST 17555-72 "Plastics. Methods for determining the content of hydroxyl groups in epoxy resins and epoxy compounds"*
- Identification of polymer defects, *ASTM D5477-11 "Standard Practice for the Identification of Polymer Layers or Inclusions using IR Fourier Micro Spectroscopy"*
- Methyl groups, *ASTM D 2238-92(2012)e1 "Method for Determining Methyl Group Absorption in PE by IR band 1378 cm^{-1}"*
- Unsaturated vinylidene, *ASTM D 3124-98(2011) "Method for the determination of unsaturated vinylidene in polyethylene using infrared spectrometry"*
- Vinyl and trans-saturation, *ASTM D 6248-98(2012)e1 "Method for the determination of vinyl and trans-saturation in polyethylene by infrared spectrometry"*
- Structural characteristics, *ASTM D 5576-00(2013) "Method for Determining Structural Characteristics in Polyolefins and Polyolefin Copolymers using IR Fourier Spectrometry"*

Petrochemistry

- Determination of oxygenates in gasoline, *GOST R52256-2004 (ASTM D5845-95) "Gasoline. Determination of MTBE, ETBE, TAME, DIPE, methanol, ethanol and t-butanol by infrared spectroscopy"*
- Determination of benzene content in gasoline, *GOST R51930-2002 "Motor and Aviation Gasoline. Determination of benzene by infrared spectroscopy", ASTM D6277-07(2012) "Test Methods for Determining Benzene Content in Internal Combustion Engine Fuel Using Mid-Space Infrared Spectroscopy", EN 238:1996/A1:2003 "Liquid petroleum products. Carburetor fuel. Determination of benzene content by infrared spectrometry"*
- Determination of fatty acid methyl esters (FAME) in diesel and residential heating fuels, *GOST R EN 14078-2010 "Liquid petroleum products. Determination of fatty acid methyl esters (FAME) in middle distillates by infrared spectroscopy"*
- Determination of operating lubricating oils, *ASTM E2412-10 "Standard methodology for monitoring the condition of operational lubricants using infrared Fourier transform-based trend analysis", MI 01-THA-09 "Methods of research of working lubricating oils by infrared Fourier spectroscopy", STO Gazprom 2-2.4-134-2007 "Methods of evaluating the operational properties of lubricating oils", DIN 51453-2004 "Lubricant tests. Determination of oxidation and nitration of the used motor oils by infrared spectrometry", DIN 51452-1994 "Lubricant oils. Determination of soot content in used diesel engine oils by means of infrared spectrometry"*
- General principles of petroleum product testing, *DIN 51451-2004 "Oil and similar products. Tests. General principles of spectrometric analysis in the field of infrared radiation"*

Coal industry

- Qualitative and quantitative analysis of compounds included in the coals, *GOST R 52205-2004 "Stone coals. Method of spectrometric determination of genetic and technological parameters"*
- Determination of sulfur in hard and brown coals, lignites, anthracites, coke, *GOST R 53356-2009 (ISO 19579:2006) "Solid mineral fuel. Definition of sulphur with use of infra-red spectrometry"*

Environmental Control

- Content of oil products in soil, *GOST R 54039-2010 "Soil Quality. Express method of infrared spectroscopy to determine the quantity and identification of soil contamination with petroleum products, IPA F 16.2.2.22-98 "Quantitative chemical analysis of soils. Methods for measuring the mass fraction of petroleum products in mineral, organogenic, organomineral soils and bottom sediments by infrared spectrometry", RD 52.18.575-96 "Methodical instructions. Determination of gross oil product content in soil samples by infrared spectrometry. Methods of measurements", MUK 4.1.1956-05 "Determination of oil concentration in soil by infrared spectrophotometry", CE 5.22.07-2005 "Soil Quality. Methods for measuring the mass fraction of petroleum products in soils and bottom sediments using infrared spectrometric method"*
- Content of oil products in water, *GOST R 51797-2001 "Drinking water. Method for determination of petroleum products", HDP F 14.1:2:4.5-95 "Quantitative chemical analysis of water. Method for measuring the mass concentration of petroleum products in drinking, surface and waste water by the method of IR-spectrometry", HDPE F 14.1:2:4.168-2000 "Method for measuring the mass concentration of petroleum products in drinking, natural and treated wastewater by the method of IR-spectrophotometry with concentrators series KN", HDPE F 14.1:2:4. 272-2012 "Methods for measuring the mass concentration of petroleum products in wastewater by the method of infrared spectrophotometry with the use of concentrators series KN", HDP F 14.1:2:4.274-2012 "Methods for measuring the mass concentration of petroleum products in drinking water samples, natural and treated wastewater by the method of infrared spectrophotometry on a concentrator series KN with the use of tetrachloroethylene", PDP 20.1:2:3. 40-08 "Methods of oil products measurement in drinking, natural and waste water by infrared spectroscopy after tetrachloroethylene extraction", RD 52.24.476-2007 "Mass concentration of oil products in water. Methods of measurements by infrared photometric method", RD 31.27.43-81 "Instruction for determination of oil and petroleum products content in ship waters of different purposes using infrared spectrophotometry", MU 08-47/255 "Methods of measurements of mass concentration of petroleum products in heat and power, surface, underground, waste and treated sewage by infrared spectrometric and fluorometric methods"*
- Identification of water pollution sources, *ASTM D 3414-98(2011)e1 "Method for Identifying Oil Extracted from Water by Infrared Spectrometry"*
- Fat content in water, *HDPE F 14.1:2.189-02 "Methods for measuring the mass concentration of fats in natural and treated wastewater by infrared spectrophotometry with the use of concentrators series KN", HDPE F 14.1:2:4.273-2012 "Methods for measuring the mass concentration of petroleum products and fats (in their combined presence) in drinking, natural and treated wastewater using infrared spectrophotometry with the use of KN series concentrators"*
- Nonionic surfactant content in water, *HDPE F 14.1:2:4.256-09 "Quantitative chemical analysis of water. Methods for measuring the mass concentration of non-ionic surfactants (NSAB) in drinking water, natural and waste water by infrared spectrophotometry with the use of KN series concentrators"*
- Content of drilling mud components in fresh water, *M-MWI-42-98 "Method for measuring the mass concentration of aliphatic alcohol glycol ether in fresh natural water by infrared spectrometry", M-MWI-40-98 "Method of measuring the mass concentration of polyethylene glycol in fresh water by infrared spectrometry"*
- Contents of carbon monoxide, *GOST R ISO 4224-2007 "Air atmospheric. Determination of carbon monoxide content. Method of non-dispersion infrared spectrometry"*

- Content of hydrocarbons, *HDPE F 13.1:2:3.74-2012 "Methods for measuring the mass concentration of hydrocarbons (total) in the atmospheric air, air of the working zone, industrial emissions by infrared spectrophotometry with the use of concentrators series KN", STO Gazprom 10-2005 "Methodological guidelines for air environment sanitary and chemical control over hydrocarbon content at OAO Gazprom facilities, its subsidiaries and organizations"*
- Content of oil products in water, *GOST R 51797-2001 "Drinking water. Method for determination of oil products content", HDPE F 14.1:2:4.5-95 "Quantitative chemical analysis of water. Methods for measuring the mass concentration of petroleum products in drinking, surface and waste water by the method of IR-spectrometry", HDPP F 14.1:2:4.168-2000 "Methods for measuring the mass concentration of petroleum products in drinking, natural and treated wastewater by the method of IR-spectrophotometry with the use of concentrators series KN", HDPP F 14. 1:2:4.272-2012 "Methods of measuring the mass concentration of petroleum products in wastewater by infrared spectrophotometry with the use of concentrators series KN", HDP F 14.1:2:4.274-2012 "Methods of measuring the mass concentration of petroleum products in drinking samples"*

Food and perfume industry

- Determination of the mass fraction of trans-isomers of oleic acid in the fat extracted from the spread or melted mixture in terms of methylelaidate, *GOST R 52100-2003 "Spreads and melted mixtures. General Technical Specifications", p.7.11*
- Determination of mass fraction of isolated trans isomers in fat products with trans isomer level ≥ 5%, *GOST R 52677-2006 "Vegetable oils, animal fats and products of their processing. Methods for determining the mass fraction of trans-isomers of fatty acids", ISO 13884:2003 "Animal and vegetable fats and oils. Determination of the content of selected trans isomers by infrared spectrometry", ISO 13884:2003, "Animal and vegetable fats and oils"*
- Determination of acid number, peroxide number, anisidine number, mass fraction of phosphorus-containing substances, mass fraction of erucic acid (for cruciferous seed oils), mass fraction of fatty acid trans isomers, *GOST R 54896-2012 "Vegetable oils. Determination of quality and safety indicators by near infrared spectrometry"*
- Determination of moisture, fat and protein (NIR), *GOST 30131-96 "Cake and meal. Determination of moisture, fat and protein by near infrared spectroscopy"*
- Determination of mass fraction of protein, fat, water, phosphorus, calcium and ash (BIC), *GOST R 52421-2005 "Fish, seafood and products from them. Method for determination of mass fraction of protein, fat, water, phosphorus, calcium and ash by spectroscopy in near infrared region"*
- Determination of mass fraction of trans-isomers of oleic acid in the fat extracted from spread or melted mixture, *GOST R 52100-2003 "Spreads and melted mixtures. General Technical Specifications", paragraph 7.11*
- Determination of the mass fraction of isolated trans isomers in fat products, *GOST R 52677-2006 "Vegetable oils, animal fats and products of their processing. Methods for determination of the mass fraction of trans-isomers of fatty acids", ISO 13884:2003 "Animal and vegetable fats and oils. Determination of the content of selected trans isomers by infrared spectrometry"*
- Mass fraction of isolated trans-isomers of fatty acids, *GOST R 52677-2006 "vegetable oils, animal fats and products of their processing. Methods for determining the mass fraction of trans-isomers of fatty acids", ISO 13884:2003 "Animal and vegetable fats and oils. Determination of the content of selected trans isomers by infrared spectrometry"*
- Determination of acid number, peroxide number, anisidine number, phosphorus content mass fraction, erucic acid mass fraction (for cruciferous seed oils), fatty acid trans-isomer mass fraction, *GOST R 54896-2012 "Vegetable oils. Determination of quality and safety indicators by near infrared spectrometry"*

Compound Feed Industry

- Contents of raw protein, raw fiber, raw fat and moisture, *GOST R 50817-95 "Feed, mixed fodder. Method for determination of raw protein, raw fiber, raw fat and moisture content using near infrared spectroscopy"*
- Contents of raw ash, calcium and phosphorus, *GOST R 50852-96 "Feed mix, feed raw materials. Method for determination of raw ash, calcium and phosphorus content using near infrared spectroscopy"*
- Contents of exchange energy, *GOST R 51038-97 "Feed vegetable and compound feed. Method for determination of exchange energy content using near infrared spectroscopy"*

Medicine

- Early diagnostics of oncological diseases based on the method of blood serum spectral analysis, *FS №2008/245 of 18.11.2008 "Differential diagnostics of malignant neoplasms and somatic malignant diseases by the method of IR blood serum spectrometry"*
- Diagnostics and control of chronic tonsillitis treatment based on infrared spectrometry, *Patent for invention No. 2261048 "Method of differential diagnostics of the compensated and decompensated form of chronic tonsillitis"*

Emergency control

- Fire engineering expertise, *UDC 614.841.2.001.2 "Application of infrared spectroscopy in the examination of objects taken from the fire site. Methodological Manual"*

Electronics industry

- Semiconductor silicon, *SEMI MF 1188 "Control of interstitial oxygen concentration in silicon", SEMI MF 1391 "Control of carbon substitution concentration in silicon", SEMI MF 951 "Control of radial inhomogeneity of interstitial oxygen", SEMI MF 95 "Control of thickness of epitaxial layers of silicon in n-n+, p-p+ structures"*

Optical manufacturing

- Determination of spectral attenuation index, *GOST 3520-92 "Optical materials. Methods of determination of attenuation indexes"*
- Measurement of spectral transmittance coefficient, *GOST R 51854-2001 "Lenses sunglasses. Technical requirements. Methods of testing"*
- Control of spectral reflection coefficient of glasses with coating-filter and sight glasses in infrared spectral area, *GOST R 12.4.230.2-2007 "Eye protection means. Methods of testing of optical and non-optical parameters", p.5.8 and Annex D*

Electric Power

- Determination of aromatic hydrocarbons, *GOST 28640-90 (IEC 590-77) "Mineral electric insulating oils. Method for determination of aromatic hydrocarbons"*
- Identification of oils (oil batches) and identification of certain types of contaminants, *ASTM D2144 - 07 "Standard methods for the study of electrical insulating oils on the absorption of infrared radiation"*

Gas analysis

- Analysis of multi-component gas mixtures, *FSM MI-1-2013 "Methods of measuring the molar (volume) fraction of carbon monoxide, ammonia, benzene, toluene and trichloroethylene in the atmosphere and in the air of the working zone"*
- Testing of gas masks – determination of the suction coefficient under the mask of sulphur hexafluoride (gas mask), *GOST 12.4.189-99 "System of labor safety standards. Individual respiratory protection means of the mask. General technical specifications" item 7.17 Mask suction factor*
- Analysis of multi-component gas mixtures, *FSM MI-1-2013 "Methods of measuring the molar (volume) fraction of carbon monoxide, ammonia, benzene, toluene and trichloroethylene in the atmosphere and in the air of the working zone"*

Textile industry

- Determination of the mass fraction of polyester fiber in the mixture with natural fibers, determination of the quantitative content of substances extracted by organic solvents (paraffin, soft paraffin, fatty wax oils), *GOST 30739-2001 "Fabrics and products clean, linen and semi-fabricated. Rapid test methods"*

Diamonds

- Revealing of the artificial diamonds which are given out for natural, type and quantity of impurity, *GSSSD 36-82 "Diamond natural. Light transmission in the range of wavelengths 0.2-25 microns"*

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