Science and Innovation. 2014. V. 10. No. 2. P. 58–63

Khokhlov, S.V. and Smyrny, M.A.

Representative Office of Thermo Techno LLC in Ukraine, Kyiv

THE *THERMO TECHNO* MODERN ANALYTICAL EQUIPMENT FOR RESEACH AND INDUSTRIAL LABORATORIES

A brief overview of some models of Thermo Techno analytical equipment and possible areas of their application is given. Thermo Techno Corporation was established in 2000 as a part of representative office of Thermo Fisher Scientific International Corporation, a world leader in manufacturing analytical equipment. Thermo Techno is a unique company which has its integrated approach to providing the user with support in solving its tasks, which includes a series of steps: setting of analytical assignment, selection of effective analytical methods, sample delivery and preparation, as well as data transfer and archiving.

Key words: Thermo Fisher Scientific, X-ray spectroscopy, powder X-ray diffraction, elemental and phase composition, X-ray fluorescent analyzer, dispersed systems, and particle size analysis.

Techno Thermo LLC is exclusive distributor of *Thermo Fisher Scientific* Corporation (Massachusetts, USA) in Russia and the CIS countries. *Thermo Fisher Scientific* Corporation is the world largest manufacturer of analytical equipment. The company provides the customers with comprehensive technical and analytical support and actively implements new forms of cooperation in the course of elaboration and validation of new analytical methods, design, and development of appropriate software.

We successfully collaborate with research organizations and universities, machine-building, metallurgy, cement, petroleum, and glass industries, etc.

The methodological support is provided to the user at the stage of selection of equipment and implementation of analytical techniques at the enterprise.

The *Thermo Techno*'s Department for Methodological Support established in 2007 deals with organizing the scientific seminars on various methods of material research and conducting individual training of users.

The collaboration between *Thermo Techno* and the National Academy of Sciences of Ukraine has been resulted in the opening of state-of-the-art X-ray diffraction demonstration center at the Lashkariov Institute for Semiconductor Physics of NASU.

The X-ray diffraction technique allows the users to analyze a wide range of the natural and the synthetic materials (both of the organic and the inorganic nature), such as semiconductors, various minerals, metals and alloys, cement, building materials, refractories, etc. The additional options of diffraction meter allow the researchers to study the properties of materials under a wide range of temperature conditions, which is very important for both the fundamental research and the applications.

THE *THERMO TECHNO* RESEARCH ANALYTICAL EQUIPMENT

1. Optical emission spectrometry

The optical emission spectrometers (OES) manufactured by *Thermo Fisher Scientific* Corporation are tools for solving the scientific, research and analytical tasks of metallurgical and enginee-

ring complex: input control, process control, and control of finished products, etc.

The **ARL *iSpark*** innovative optical emission spectrometer (Fig. 1) is a high-quality optical emission spectrometer based on the best photomultiplier tube (PMT) optics.

The ARL *iSpark* spectrometer is characterized by the most sensitive optics based on CCD (Charge Coupled Device), advanced functionality, and other innovative technologies:

- Unique PMT-optics combined with CCD optics;
- Revolutionary digital generator;
- Innovative design of spark stand;
- Advanced algorithms for receiving and processing the PMT and CCD signals;
- Operation with single discharges using the algorithms for moving the intensity of scattered sparks in order to improve the PMT accuracy;
- Maximally advanced analysis of micro-inclusions; and
- Efficient process control of argon purification in argon-save mode.

The **ARL 3460/4460** multichannel optical emission spectrometer (Fig. 2) is designed for fast and efficient analysis of metals in various industries. The spectrometer functional features are as follows:

- Wide range of elements analyzed and calibration of CNOPS-elements;
- Identification of nonmetallic inclusions in samples (optional SparkDat);
- Purity index calculation;
- Analysis of samples having a diameter of 1 mm or more (for the sample of a diameter of up to 1 mm the ARL 4460 is used).

2. XRF analysis

The **ARL QUANT'X** tabletop energy dispersive spectrometer (Fig. 3) is a device of the newest generation. It i a chemical composition analyzer designed for solving a wide range of analytical tasks.

The spectrometer functional features are as follows:

- Express analysis of elements ranging from Na to U;
- Sensitivity within the range from <1 ppm to 100%;
- Time measurement of one element from a few seconds to several hours;
- Sample positioning with visual control via CCD-camera;
- Adjustable size of X-ray beam from 1 to 10 mm;
- Exclusive Si (Li)-detector with electric cooling.

The **ARL OPTIM'X** wavelength X-ray fluorescence spectrometer (Fig. 4) has the following salient analytical features:

- Analysis of elements from F to U;
- Analysis of solid, liquid, and powder samples;
- Simultaneous identification of up to 8 elements (on 4 multichromators);

Fig. 1. ARL *iSpark* optical emission spectrometer

Fig. 2. ARL 3460/4460 multi-optical emission spectrometer

Fig. 3. ARL QUANT'X desktop energy dispersive spectrometer

Fig. 4. ARL OPTIM'X X-ray fluorescent spectrometer

- Sequential simultaneous analysis: Smart Gonio and multichromator;
- Standard-less analysis programs;
- Power options: 50 W or 200 W;
- Operation without external cooler;
- Durable gearless mechanism.

The **ARL PERFORM'X** wavelength X-ray fluorescence spectrometer for sequential analysis (Fig. 5) is an advanced platform for fast and accurate analysis of up to 90 elements of both solid and liquid samples from Be to U. The possibility of mapping the sample with ARL PERFORM'X allows for visualizing the distribution of elements on inhomogeneous surface.

The analysts may identify and characterize the inclusions, contaminations, and gradients, which cannot be identified by other methods.

The spectrometer functional features are as follows:

- Simple and fast sample preparation;
- Analysis of the whole surface, its segments or individual points;
- Fastest wavelength spectrometer (up to 60 samples / hour);
- Highest reproducibility and accuracy of analysis;
- Wide dynamic range (from ppm levels to 100%);
- Quick and simple analysis of unknown samples with the help of advanced software;
- Power option: 1.2 kW, 2.5 kW, 3.6 kW, and 4.2 kW with external cooler.

3. Combined System of XRF and XRD spectrometer

The **ARL 9900 WorkStation** device (Fig. 6) combines two technologies: XRF + XRD. The XRF series instruments are designed to control the finished products in various industries on the basis of patented technique of combined X-ray fluorescence (XRF) and X-ray diffraction (XRD) (optional) analysis in one instrument.

The functional features of device are as follows:

- Sequential and / or simultaneous elemental and comprehensive phase analysis in one multichannel device;
- Up to 32 channels for simultaneous analysis;
- Full-sized diffraction meter with Co or Cu X-ray tubes;
- Selection of generator parameters depending on purpose: 600W, 1.2 kW, 2.5 kW, 3.6 kW or 4.2 kW;
- Vertical position of X-ray tube prevents contamination of device by sample material;
- *Quantas*, *UniQuant*, and *OptiQuant* standard-less analysis program.

4. X-ray diffraction

X-ray diffraction is a versatile non-destructive analytical method providing information on the structure and phase composition of various materials. The **ARL XTRA** powder X-ray diffraction meter (Fig. 7) is used to analyze the phase composition of materials.

The device functional features are as follows:

- Identification of sample's phase composition;
- Quantification of known phases in the mixture;
- Identification and clarification of crystal structure;
- Analysis under various conditions: high and low temperature, high pressure and/or active gaseous environment;
- Analysis of surfaces and thin films;
- Analysis of textures and micro-strains.

THE *THERMO TECHNO* ANALYZERS OF PARTICLE AND PORE SIZE

The *Thermo Techno* equipment for the comprehensive study of nanoparticles (measurement of size, concentration, zeta potential, and molecular weight, mass of particles in organic and inorganic dispersions, emulsions and solutions of polymers, and biomolecules with volume concentration of dispersed phase up to 50 vol. % without dilution) includes the following tools:

1. The automated **POROSIMETER 3.2** based on the principle of reference capillary porosimetry. After preparing a package of samples and standards the device performs all the measurement procedures on the basis of integrated program in automatic mode. The method has successfully applied to the study of catalysts, electrodes with extended surface, adsorbents, filter materials, building materials, etc.

2. The ***Brookhaven* 90Plus / ZetaPlus / Zeta PALS** versatile series of instruments for measuring the size and zeta potential of nanoparticles in a wide variety of solvents: depending on the needs the device can have the options to analyze the size or zeta potential and to combine these functions separately and entirely.

Fig. 5. ARL PERFORM'X X-ray fluorescent spectrometer

Fig. 6. ARL 9900 WorkStation combined XRF and XRD spectrometer system

Additionally, the configuration can include options for measuring the molecular weight of polymer macromolecules and automatic titrator.

3. The ***Brookhaven* NanoDLS** special instrument for nanoparticle size analysis in on-line and batch mode is ideal for use as an independent particle size detector for liquid chromatography (in particular, for gel filtration). As part of the ACOS automated system it applies to on-line monitoring of nanoparticle size in reactor (e.g., during their fusion).

Fig. 7. ARL XTRA X-ray diffraction meter

Method of nanoparticle tracking analysis (NTA) offers a unique approach to multi-parametric characterization of colloidal solutions. The *particle-by-particle* mode provides for measuring the particle size, intensity of particle scattering or fluorescence (optional), zeta potential (optional), and particle concentration of each fraction. The method makes it easy to analyze both the monomodal distribution and the complex multi-fractional nanoparticle mixtures. The method can be used both independently and in conjunction with DLS-particle size analyzer. The NTA-based devices have successfully applied to the general characterization of nanoparticle solutions, analysis of size and titer of virus particles in pharmaceutical research, as well as to the study of protein aggregation and the clinical diagnostics for counting and typing of exosomes. Below, there are given several examples of equipment whose operating principle is based on the above method.

4. ***Nanosight*** **LM10** is the most descriptive instrument based on binocular microscope. It has the manual procedure for setup of optical system with visual control; manual sample entry (by 1-2 ml syringe); can be equipped with a thermo-stabilized cell and a highly sensitive camera for analysis of small and/or weakly scattering particles, as well as an option for analysis of fluorescent particles.

5. ***Nanosight*** **NS500** is a versatile automated device with thermo-stabilized cell, motorized optical table controlled by computer, two peristaltic pumps for sample introduction and rinse of the measuring cell. It can be equipped with options for analysis of fluorescent particles and zeta potential, as well as with highly sensitive camera, and autosampler.

С.В. Хохлов, М.А. Смирний

СУЧАСНЕ АНАЛІТИЧНЕ ОБЛАДНАННЯ КОМПАНІЇ «ТЕРМО ТЕХНО ЛЛС» ДЛЯ НАУКОВИХ ДОСЛІДЖЕНЬ ТА ПРОМИСЛОВИХ ЛАБОРАТОРІЙ

Наведено короткий огляд деяких моделей аналітичного встаткування компанії «Термо Техно» і можливихобластей його застосування. Компанія «Термо Техно» була створена в 2000 р. як представництво міжнародної корпорації Thermo Fisher Scientific – світового лідера у виробництві аналітичного встаткування. Унікальність роботи «Термо Техно» полягає у комплексному підході до вирішення завдань користувача, що зводиться до виконання цілого ряду етапів: постановка аналітичного завдання, вибір ефективних методів аналізу, відбір, доставка й підготовка проби, а також спосіб передачі й архівування даних.

Ключові слова: Thermo Fisher Scientific, рентгенівська спектроскопія, порошкова рентгенівська дифракція, елементний і фазовий склад, рентгенофлуоресцентний аналізатор, дисперсні системи, аналіз розмірів частинок.

С.В. Хохлов, М.А. Смирный

СОВРЕМЕННОЕ АНАЛИТИЧЕСКОЕ ОБОРУДОВАНИЕ КОМПАНИИ «ТЕРМО ТЕХНО ЛЛС» ДЛЯ НАУЧНЫХ ИССЛЕДОВАНИЙ И ПРОМЫШЛЕННЫХ ЛАБОРАТОРИЙ

Представлен краткий обзор некоторых моделей аналитического оборудования компании «Термо Техно» и возможных областей его применения. Компания «Термо Техно» была создана в 2000 г. как представительство международной корпорации Thermo Fisher Scientific – мирового лидера в производстве аналитического оборудования.

Уникальность работы «Термо Техно» состоит в комплексном подходе к решению задач пользователя, который заключается в выполнении целого ряда этапов: постановка аналитической задачи, выбор эффективных методов анализа, отбор, доставка и подготовка пробы, а также способ передачи и архивирования данных.

Ключевые слова: Thermo Fisher Scientific, рентгеновская спектроскопия, порошковая рентгеновская дифракция, элементный и фазовый состав, рентгенофлуоресцентный анализатор, дисперсные системы, анализатор размеров частиц.

Received 25.12.13