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ЗАВОДСКАЯ ЛАБОРАТОРИЯ

ДИАГНОСТИКА МАТЕРИАЛОВ

ЕЖЕМЕСЯЧНЫЙ НАУЧНО-ТЕХНИЧЕСКИЙ ЖУРНАЛ ПО АНАЛИТИЧЕСКОЙ ХИМИИ, ФИЗИЧЕСКИМ,
МАТЕМАТИЧЕСКИМ И МЕХАНИЧЕСКИМ МЕТОДАМ ИССЛЕДОВАНИЯ, А ТАКЖЕ СЕРТИФИКАЦИИ МАТЕРИАЛОВ

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ABSTRACTS

UDC 543.421

Development and Properties of Activated Carbon Based Iron-Containing Chemical Modifier for Electrothermal Atomic Absorption Determination of Volatile Elements*Burylin M. Yu., Malykhin S. E., Galai E. F.*

Quantum chemistry approach is used to calculate the chemisorption energy of As, Se, Pb, and Cd atoms on metal iron surface. A possibility of analytical application of iron-containing chemical modifier (ICM) based on activated carbon to ETAAS determination of volatile elements is considered. Methods of thermodynamic modeling, thermal analysis and ETAAS are used to substantiate the procedure of ICM preparation which ensures the formation of the metallic phase Fe⁰ and low-temperature thermal stabilization of the analytes. The developed chemical modifier is used to determine the content of As, Cd and Pb in the suspensions of seaweed reference standard. The obtained results match satisfactory the certified values.

Keywords: iron; activated carbon; chemical modifier; atomic absorption spectrometry; thermodynamic modeling; quantum chemistry; volatile elements.

UDC 546.77.543.42

Ion-Exchange Conditioning and Spectrophotometric Determination of Mo in Sea Water*Mirzaeva Kh. A., Byurnieva U. G., Gamzatova P. A.*

A possibility of using KU-2 cation exchanger and AN-31 anion exchanger for molybdenum concentrating is demonstrated. pH of the solution is shown to be a decisive factor in sorption process, the molybdenum concentrating in anionic form MoO₄²⁻ in the anionite column being more selective. The technique of spectrophotometric determination of Mo (VI) in sea water with dibromopyrogallolsulfonphthalein and cetylpyridinium chloride and preliminary ion-exchange concentrating is developed. Reproducibility of the results is better when using the anionite column (S_r is no more than 10⁻²).

Keywords: molybdenum; ion-exchanger concentrating; selectivity; spectrophotometry; the analysis of sea water.

UDC 543.544.43

Formate and Sodium Nitrite Determination in Antifreeze Admixtures for Concrete and Mortar Using Headspace Gas Chromatography*Zamuruev O. V., Petrovich O. M., Dubyakov T. V., Vovk A. I.*

A procedure of rapid determination of sodium formate and sodium nitrite in blended antifreeze admixtures for concretes and mortars using headspace gas chromatography is described. The optimal conditions of analysis realization are specified. The method has been approved and introduced into production control process at the enterprises of the JSC «Polyplasts».

Keywords: headspace gas chromatography; antifreeze admixtures for concretes and mortars; sodium formate; sodium nitrite; polycarboxylate; polymethylenenaphtalene-sulfonate; sodium lignosulfonate.

UDC 543.42.062:546.62

Extraction-Photometric Determination of Mn (II) with 2-Hydroxy-5-chlorothiophenol and Aminophenols in Natural and Industrial Objects*Zalov A. Z.*

Complexing of manganese (II) with 2-hydroxy-5-chlorothiophenol and aminophenols (Aph) and optical properties of different-ligand complexes (DLC) thus formed are studied. Molar extinction coefficients [$\epsilon = (2.10 - 2.45) \times 10^4$] of the complexes are determined. DLC absorption spectra peaks within the range of $\lambda_{\max} = 380 - 410$ nm. The developed method of extraction-photometric determination of Mn (II) is approved in analysis of standard samples of alloys and samples of drinking water and parsley leaves.

Keywords: complex formation; extraction; chloroform; manganese; 2-hydroxy-5-chlorothiophenol; Beer's law.

UDC 669.539.382:669:17:669.046

Comparative Analysis of Structure-Phase States in Rails Subjected to Differential and Bulk Oil Hardening*Morozov K. V., Gromov V. E., Ivanov Yu. F., Glezer A. M., Bataev V. A.*

A comparative analysis of the structure, phase composition and dislocation substructure formed at different depth below the rail head running surface along the central axis and fluting of the rails subjected to bulk oil hardening and differential hardening by compressed air is presented. The cementite volume fraction, α -Fe lattice parameter, microstresses, areas of coherent scattering, relative content of structure components, interlamellar distance, density of bend extinction contours are analyzed.

Keywords: structure; phase composition; rails; hardening; electron microscopy.

UDC 621.315

Determination of the Recombination Center Parameters in Power Semiconductor Devices*Bulyarskii S. V., Zhukov A. V., Ermakov M. S.,**Lakalin A. V., Sergeeva O. A.*

New differential methods for determining the parameters of the recombination centers that form deep levels in the band gap of a semiconductor are described. An ex-

ample of gold impurities in silicon is considered. Approbation showed rather high accuracy of the proposed methods of processing current-voltage characteristics with a systematic error of no more than 0.05 eV for the activation energy of deep levels. Easy to use procedure and available equipment make the method advantageous for diagnostics of the recombination centers in power semiconductor devices when the use of capacitive methods is difficult.

Keywords: $p-n$ -transition; recombination; recombination centers; activation energy; capture coefficients; method of determining the parameters.

UDC 543.544

Ring Capillary Chromatograph

Kazakov L. I., Nikolaev Yu. N.

A new type of capillary chromatography in which capillary is a narrow gap between coaxial cylinders is developed. The interior face of the first stationary cylinder is covered with a liquid film of stationary phase and the other cylinder rotates uniformly lugging off the carrier gas present in the gap and test gas sample split into separate binary strips of impurities, each of them moving in the gap with their own speed and frequency. Synchronous moving of the impurity strip along liquid stationary phase is described. The possibility of multiple periodic measurements of the strips inside the capillary, accuracy of the results, as well as representation of the chemical composition of the sample as a frequency spectrum of the sum time signal of the detector are the distinctive capabilities of the developed chromatograph. Annular chromatograph may be compact, portable, with a simple mechanical drive like winding spring and does not require pressure carrier gas tanks.

Keywords: distribution coefficient; convective diffusion; mass transfer; HETP; ultrasonic detector; TCD (catharometer); accumulation method; spectral analysis.

UDC 539.25

Electromagnetoacoustic Receiver for Measuring the Rayleigh Wave Velocity on Small-Scale Surface Area

Tolipov Kh. B.

An experimental setup for recording acoustic pulses from a small surface area is presented. The main feature of the setup is the contactless electromagnetoacoustic receiver, wherein the inductor is made of a thin straight conductor. The setup was tested in recording the pattern of standing wave originating in the tapered plate near the edge. Step of scanning the plate surface by electromagnetoacoustic receiver is 0.5 mm. The surface wave velocity is determined by measuring the time of wave travel between the two thin straight parallel conductors that formed the measurement base. The oscillation frequency varied within a wavelength range of 2 – 10 MHz which corresponded to change in the surface acoustic wave length from 600 to 240 μm . A new procedure of measuring the time interval between two acoustic pulses providing more accurate wave velocity determination is developed.

Keywords: acoustic wave; residual stress; acousto-elasticity; theory of elasticity; standing waves.

UDC 620.191.33

A Sample for Determination of the Characteristics of Static and Cyclic Crack Resistance

Georgiev M. N., Morozov E. M., Simonov Yu. N.

The advantages of standard limit fracture toughness and crack resistance diagram compared to other standard characteristics of crack resistance under static loading are discussed. We developed a sample similar to the compact reference standard but providing determination (in addition to the limit fracture toughness) the threshold range of the stress intensity factor under cyclic loading. A possibility of using experimental results both for evaluation of the crack resistance of the material and for calculation of the strength of structural elements with cracks is demonstrated. The results of some experiments are presented and discussed.

Keywords: fracture toughness; limit crack resistance; crack resistance diagram; compact samples.

UDC 620.168.37:531.781

Allowance for Temporal Stability of Residual Magnetization in Stress Diagnostics by Magnetoelastic Demagnetization

Novikov V. F., Sorokina S. V., Muratov K. R., Ustinov V. P.

A possibility of using magnetoelastic demagnetization in control the mechanical stresses is considered. The results of studying the time dependence of the magnetic field strength of the local magnetization of the steel sample under different loading and thermal treatment are presented. It is shown that temporal stability of residual magnetization should be taken into account in long-term tests by the method of magnetoelastic demagnetization.

Keywords: stress-strain state; magnetoelastic demagnetization; magnetoelastic memory; monitoring of buildings and structures; range of scatter; coercive force; relaxation processes.

UDC 620.178.152

Diagnosis of the Mechanical Properties of Materials from the Indentation Diagrams at Different Scale Levels

Matyunin V. M., Marchenkov A. Yu., Volkov P. V., Demidov A. N.

Methods and devices for determination of the mechanical properties of materials from indentation diagrams and scratching are analyzed. The capabilities and advantages of the indentation method are demonstrated at different scale levels. A novel

procedure of hardness evaluation based on analysis of pyramid indentation diagrams is developed. The ranges of efficient use of indentation methods in diagnostics of the mechanical characteristics of materials are marked.

Keywords: indentation; indentation diagrams; mechanical properties; scale effect; diagnostics of the materials.

UDC 620.172.251.222

Method of Yield Point Determination in Carbon Steels

Matlin M. M., Dudkina N. G., Samoilo N. É.

A technique for determining the yield point of materials is described. The procedure is based on determination of the diameter of the build-up zone around the cone indenter impression (lip angle is 90°) at a constant load. The diameter of the build-up zone is determined by recording the depth and height of indentation on the original surface. The method is intended for engineering strength calculations and evaluation of the strength properties of materials.

Keywords: yield stress; diameter; build-up area; cone; steel.

UDC 620.172:539.376

Creep of ChNKhMD Heat-Resistant Cast Iron under Tensile and Compression

Buketkin B. V., Shirshov A. A.

High-strength heat-resistant cast iron is widely used in production of sleeve assemblies for modern transport diesel engines operating under varying loads. High temperatures entail the development of irreversible creep strain resulting in residual tensile stresses after the engine stopping. To calculate the level of residual stress it is necessary to have information on the creep of heat-resistant iron which can be obtained experimentally. Thus, we used data of tension and compression tests of the specimens in creep conditions to derive an analytic dependence (state equation) valid for calculations at variable temperatures and stresses which describes the first and second creep stages. The resulting state equation can be used for calculations of ChNKhMD heat-resistant cast iron under creep conditions at a temperature up to 500°C.

Keywords: heat-resistant cast iron; creep under tension; creep under compression; the state equation.

UDC 543.422.8,681.3.06

Trends of Development, Software Engineering and Support of Domestic Analytical Laboratories

Molchanova E. I., Shcherbakov I. V., Fedorov V. V., Kuz'min V. V.

Information systems corresponding to three lines of computerizing analytical laboratories (according to V.I. Dvorkin classification) are considered. For each class we highlighted trends and emerging operation technologies. It is shown that LIMS (laboratory information management systems) despite their high cost and complexity are increasingly used for product quality management and automation of analytical control in automated process control systems (APCS).

From the viewpoint of application of the selected technologies automated system of analytical monitoring (ASAM) is considered as SCADA-system. Intellectualization of ASAM entails using of expert systems (ES). «Scattered» («cloud») technology (in which computer resources and capacity are available to the user as an Internet service) of data processing is considered the most promising one. The technology and prototypes of information and algorithmic support of intelligent ASAM are developed in the context of «cloud» data processing to improve the efficiency of analytical control of the content of technological products. An approach to creation of hybrid expert systems as Web-applications is proposed. The approach is based on the development of a unified model of the knowledge base not anchored to the domain ontology. CLIPS system is used as a «solver» and interaction of the expert-system shell with application program package is under control of specially developed daemon.

Keywords: laboratory software; LIMS; ASAM; Web-technologies; SCADA-system; hybrid expert system; knowledge base; database; CLIPS; inference engine; application program package; X-ray fluorescence analysis.

UDC 53.089.68

Terminology in the Field of Reference Material — Translation Features

E. A. Anchutina

Examples of the difficulties in translation and perception of English terms in the field of reference material attributed to different conceptual foundations of some terms, as well as to the subjectivity of their translation are considered.

Keywords: ISO Guides; reference material; certified reference material; reference material certificate; terminology.

Update Status and Development of the Methods for Technical Diagnostics

Klyuev V. V., Artemiev B. V., Matveev V. I.

A brief review of applied research and development in the field of non-destructive control and technical diagnostics is presented. An emphasis is made on the results published by UAB RII «Spectrum» in 2014. Thematic priorities: industry-related diagnostics, antiterror preventive maintenance, medical x-ray diagnostics and environmental control.

Keywords: non-destructive testing; technical diagnostics; x-ray control; magnetic testing; ultrasonic testing; eddy current testing; optical control; thermal control; radio-wave control; safety.