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ЛАБОРАТОРИЯ  
ДИАГНОСТИКА МАТЕРИАЛОВ

2015  
МАРТ

# ЗАВОДСКАЯ ЛАБОРАТОРИЯ

## ДИАГНОСТИКА МАТЕРИАЛОВ

№3 ТОМ 81  
2015

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

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представлен сайт:

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E-mail: [zvlabor@imet.ac.ru](mailto:zvlabor@imet.ac.ru)

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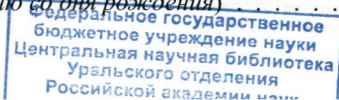
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UDC 543.6:546.9  
**Methods of Studying Anthropogenic Environmental Impact of Platinum Group Metal Contaminants (Review)**  
*Zhitenko L. P., Kiseleva I. N., Khomutova E. G.*  
 A variety of analytical procedures used to study anthropogenic pollution of the environment with platinum group metals (PGM) published in 2011 – 2013 are reviewed. Data on PGM contents in urban environmental samples obtained during the last few years are presented and discussed.  
**Keywords:** platinum group metals; environmental samples; analytical methods; anthropogenic contaminations.

UDC 543.545.2;543.399  
**Determination of Chlorovinylarsonous and Chlorovinylarsonic Acids in Water Samples by Capillary Electrophoresis with Direct Photometric Detection**  
*Rodin I. A., Stavrianidi A. N., Braun A. V., Baygildiev T. M., Shpigun O. A., Rybalchenko I. V.*  
 A new approach to determination of chlorovinylarsonous and chlorovinylarsonic acids in water samples by capillary zone electrophoresis is developed. Those compounds are the products of lewisite decomposition and belong to the class of skin-vesicants. Optimization of determination conditions includes a choice of the wavelength and detection mode, composition of the working buffer, sample injection volume and program of conditioning the working capillary. The developed method is characterized by high accuracy, reproducibility, selectivity of determination and lack of interference effect of the natural water matrix components. The method was tested in analysis of different real water samples. Detection limits determined at direct spectrophotometric detection ( $\lambda = 195 \text{ nm}$ ) for chlorovinylarsonous and chlorovinylarsonic acid in water samples are 0.3 and 0.5 mg/liter, respectively.  
**Keywords:** lewisite transformation products; capillary zone electrophoresis; water analysis.

UDC 543.423  
**On the Capabilities of Improving Metrological Characteristics of Atomic-Emission Analysis of Bottom Sediments**  
*Akhsanova O. L., Gilaeva G. V., Zagitov R. M., Nikonorova V. N.*  
 The effect of different carries in the system «graphite powder – carrier» on the plasma parameters upon determination of heavy metals is studied. Qualitative and quantitative composition of spectroscopic buffer and conditions for spectral analysis of bottom sediments are optimized. The obtained results are used to develop a technique for determination of heavy metals in wastewater sludge at sewage treatment plants.  
**Keywords:** atomic-emission analysis; bottom sediments; heavy metals; spectroscopic buffer.

UDC 543.632  
**Simultaneous Determination of Tributyl Phosphate and Sodium Cholate in Blood Products Using HPLC-MS**  
*Khasanov V. V., Dychko K. A., Kuryaeva T. T., Khasanov V. V.*  
 Tributyl phosphate and sodium cholate are used in the processing of blood products and their content is controlled in finished formulations. An easy to use procedure for sample preparation and simultaneous direct determination of residual amounts of tributyl phosphate (TBP) and sodium cholate (SC) in blood products is developed using reversed-phase HPLC with MS detection. Though sample preparation consists only in protein precipitation; the method provides SC and TBP determination in a concentration range up to 12.5 and 0.35 mg/liter with a relative error less than 11 and 7%, respectively.  
**Keywords:** tributyl phosphate; cholate; deoxycholate; blood products; HPLC-MS.

UDC 539.53:620.22:669  
**Microhardness of a Nanostructural Composite Material**  
*Nasakina E. O., Kovaleva E. D., Sevostyanov M. A., Mikhaylova A. B., Kolmakov A. G., Zabolotny V. T.*  
 Nano- and microdimensional tantalum surface layers are obtained on flat microstructural and wire nanostructural NiTi substrates. As the time of de-

position increases the thickness of surface layer exhibits a nonlinear increase accompanied with a consecutive formation of  $\beta$ -Ta and  $\alpha$ -Ta. The microhardness of nanostructural basis and thick surface layer exceeds that of microstructural nitinol by 38% and 26%, respectively.

**Keywords:** composite materials;  $\alpha$ -tantalum;  $\beta$ -tantalum; nitinol; nano-materials; microhardness; magnetron sputtering.

UDC 669.71:537.312.6

### Control of Changes in the Microstructure and Content of Copper in Al-Mn-Cu Alloys Using Method of Thermoelectromotive Force

*Udalaya K. R., Belen'kii A. M., Alabin A. N.*

Thermoelectromotive force (TEMF) is one of traditional indirect methods of non-destructive control along with the methods of electrical resistivity, dilatometry and microhardness. We first demonstrated a possibility of TEMF application to electrical sorting of Al-Mn-Cu alloys and analyzed the effect of heat treatment and Cu content (0–7.5%) on thermoelectromotive force (TEMF) of the system Al-Mn-Cu alloys. Data on the integral TEMF, Seebeck coefficient, electrical resistivity, thermal conductivity and heat capacity are obtained in a wide temperature range of 450–500°C following 3-h annealing at 540 °C. TEMF procedure is highly sensitive to microstructural changes and content of alloying elements.

**Keywords:** Al-Mn-Cu system; thermoelectromotive force; TEMF; Seebeck coefficient; thermal conductivity; specific heat; structure control; influence of copper.

UDC 62–408

### Application of Wavelet Analysis and Fractal Theory to the Study of Microetch Images

*Akhmetkhanov R. S.*

We demonstrated the use of information technologies in analysis of microetch images. The structure of the material in studied proceeding from analysis of microetch images using the theory of fractals (fractal estimations) and wavelet analysis (a multiple-scale analysis). Fractal estimations and data obtained in wavelet analysis provide quantification of changes in the structural characteristics of the material upon accumulation of damage or structural changed attributed to different material processing technologies.

**Keywords:** microetch; structure; phase; damage; image; fractal dimension; Hurst coefficient; wavelet transforms; multiple-scale analysis.

UDC 621.891

### Assessment of the True Size of Carbide Particles in Solid Alloys Using Data of Quantitative Metallography

*Krokhalev A. V., Kharlamov V. O., Tupitsin M. A., Prikhod'kov K. V., Avdeyuk O. A., Savkin A. N., Kuz'min S. V., Lysak V. I.*

A method of indirect measurement of the true size of carbide grains in hard alloys obtained by explosion is described. The method is based on a model approximation of the structure of carbide skeleton of the alloys. The results of using the model for the study of fragmentation of carbide particles during compaction are presented.

**Keywords:** tungsten carbide; specific volume; relative surface area; true particle diameter.

UDC 620.178.16:620.18:669.245

### Mechanical and Tribological Properties of Multifunctional Composition «Matrix – Material with Shape Memory Effect»

*Blednova Zh. M., Makhutov N. A., Rusinov P. O., Stepanenko M. A.*

The properties of multifunctional composition steel – alloy with shape memory effect based on TiNi, TiNiCu, NiAl are studied. Composition is obtained in conditions of high-energy impacts (TIG and laser welding, plasma and high-speed flame spraying) with formation of the structures ranging from fine-grained to the nanoscale one. Experimental studies have shown the efficiency of the developed technologies providing composites with enhanced wear resistance, fatigue limit, and durability in conditions of friction-cyclic low-cycle loading. Increase in wear-fatigue characteristics is attributed to the process caused by the joint action of cyclic loading and reversing friction. It is shown that temperature increase in the friction zone in the surface-modified layer of the material with a shape memory effect observed in conditions of friction-mechanical fatigue triggers austenite-martensite transformation while the pressure arising upon friction at

the same time results in plasticity of transformation due to formation of martensite strain.

**Keywords:** composition «steel – alloy with shape memory effect»; high-energy impact; tribological properties; friction-mechanical fatigue; martensite-austenite transformation.

UDC 620.178.2:621.53

### Possible Scenarios of Emergencies in Tanks and Pipelines at Low Operating Temperatures

*Makhutov N. A., Bol'shakov A. M., Zakharova M. I.*

Oil and gas facilities — tanks, gas and oil pipelines — are considered high-risk objects of the technosphere. Uncontrolled development of emergencies at oil and gas facilities due to explosions and fires can result in significant damage and death of people. Presented are possible scenarios of the onset, development and probability of the accidents at oil and gas facilities operating in extreme climatic conditions of the North. The measures aimed at reducing danger are specified.

**Keywords:** risk analysis; danger; scenarios; probability

UDC 620.172.23:62–215

### Data Interpretation of the Shell Composite Construction Field Test Under Static Axial Compression

*Kaledin V. O., Razin A. F., Burnysheva T. V., Shteinbreher O. A.*

Solution of the problem of identification of actual loading condition of composite shell construction through interpretation of field test data is considered. The construction consists of a stringer compartment made of aluminum alloy and composite lattice shell. During the field experiment, a compressive load was applied to the upper edge of the stringer compartment. To solve the identification problem, the applied load is treated as a combination of compressive force and bending moment. A sum of squared deviations between measured and calculated displacements of the sensors at same points is taken as a quality criterion of identification. Numerical calculation of the displacements is carried out numerically by the method of finite elements within the software package «Kompozite». Two ways of loading modeling are considered: i) distribution of the linear load along the upper edge of the construction and ii) force and torque transmission through the «hard» node. Obtained parameters of loading through «hard» node provide matching of the calculated and experimentally measured displacements within the error of measurement. Calculation data in case of force application along the upper edge of the construction disagree with the experiment. Parameters of loading thus obtained are used in solving the problem of hatch stiffness identification.

**Keywords:** composite lattice shell; field testing; data interpretation; identification; finite element method.

UDC 519.2

### Statistics of Interval Data (generalizing paper)

*Orlov A. I.*

We consider the basic concepts of asymptotic mathematical statistics of the interval data in which the sample elements are not numbers but the intervals. Algorithms and conclusions of the interval data statistics differ fundamentally from the classical ones. The results related to the basic concepts of notna and rational sample size are presented. Statistics of interval data is a part of the statistics of non-numerical objects.

**Keywords:** mathematical statistics; interval data; asymptotic methods; notna; rational sample size; estimation; statistics of non-numerical objects.

UDC 519.24

### Development of New Modifications of Profile Classification Methods for Bilingual Text Documents and Ensemble of Classifiers Synthesis

*Mokhov A. S., Tolcheev V. O.*

We consider a problem of increasing the correctness of classifying bilingual (Russian-English) text documents. Proceeding from the known profile methods we develop new modifications and construct different ensembles of classifiers (EoC). Several EoCs which consist of different profile methods, are built. The diversity and fidelity of EoC's members are investigated. As a result, we get better accuracy with EoCs than that with a single classifier.

**Keywords:** text mining; methods of bilingual text classification; profile methods; ensemble of classifiers, accuracy (error) of classification.