

THE FURNACE FOR CRYSTAL GROWTH BY DIRECTIONAL SOLIDIFICATION METHOD IN SKULL (p. 4-7)

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The furnace, based on the skull method for obtaining laboratory samples of halide crystals (40 mm in diameter and 15 mm high) with the melting temperature of 900 °C, is considered in the paper. This technological solution allows growing crystals without using expensive platinum crucibles and moving or rotating design elements. The process control system and the thermal unit design are designed for determining and controlling temperature and a thermal gradient for carrying out crystal growth and minimizing the skull layer thickness, preventing the contact of melt with crucible and obviating crystal contamination. Placed in a vacuum vessel and sealed independently, the crucible allows controlling the impurity composition of the output crystal. The grown PbF₂ and LiF polycrystals demonstrate the effectiveness of the suggested approach in obtaining small crystals. The prospect of using this approach lies in the possibility of a transition from receiving laboratory samples of crystals to the industrial crystals.

Keywords: method of directional crystallization, skull method, crystal, laboratory facility, crystal growth.

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NUCLEAR DATA FOR NEUTRON-PHYSICAL CALCULATIONS OF THE REACTORS (p. 8-11)

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Nuclear data on nuclear reaction cross sections with gamma-quanta escape in the interaction of fast neutrons with the reactor structural materials are important for neutron-physical calculations of reactors. These data are necessary to estimate the gamma fields in the reactor core and calculate radiation protection. In addition, the study of nuclear reaction cross sections are needed to study different mechanisms of nuclear reactions and features of the excited states of nuclei and their decay.

The results of studying nuclear data on nuclear reaction cross sections on cadmium in the energy range from 2 to 8 MeV are given in the paper. The values of cross sections are recovered from the

corresponding amplitude instrument spectra, and their errors are estimated. The experimental results are compared with the results of theoretical calculations, performed within the framework of the statistical Hauser-Feshbach model, taking into account particle pre-equilibrium escape.

The obtained results are included in the international experimental nuclear data library and can be used for neutron-physical calculations of reactors. The investigated theoretical models can be used for estimating nuclear data, which are missing in the international experimental nuclear data libraries.

Keywords: nuclear data, nuclear reactions mechanisms, cross sections, gamma- fields, amplitude spectra recovery.

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MEASURING SIGNAL FORMATION IN THE BISPECTRAL PYROMETRY (p. 12-16)

Maksym Markin

The problem of forming the measuring signal in the bispectral pyrometry is considered in the paper. High-temperature technologies become effective only if the technological requirements are met, that, in its turn, is impossible without appropriate industrial gages.

A significant constraint in the field of applying monospectral television measuring devices for controlling temperature modes is the fundamental dependence of measurement results on a priori grounds about the emissivity coefficient of an object and its behavior in the measurement range. In this case, the bispectral pyrometry ensures potentially higher measurement accuracy. But a significant number of issues concerning the bispectral television pyrometry,

which are important in theoretical and practical aspects, have not received an adequate interpretation. It means that virtually today there has not been developed potentially the most efficient method for temperature control, which capabilities fully meet the needs of electron-beam technologies for obtaining new materials, laser processing technologies, welding and other related technologies.

The analysis of existing circuits of a multispectral signal formation in the pyrometry was made in the paper. There are circuits with light filters deposited on the matrix, using a polygonal prism or bilens. In the paper, it was suggested using a three-layer matrix for forming a multispectral signal. The main advantage of the circuit for forming the measurement signal is high resolution, as well as the absence of such optical system components as light filters, bilens or prism, which complicate the circuit and cause errors in measurements.

A physical model of forming measurement and output bispectral pyrometer signals was developed. Using the physical model, a mathematical model was developed.

It was concluded that there is a need of further studying properties of bispectral television measuring devices, as well as the influence of slight changes of the emissivity coefficient on errors of temperature measurements.

Keywords: measuring signal, pyrometer, bispectral pyrometry, CCD, television camera, measurement, temperature

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ESTIMATING METROLOGICAL CHARACTERISTICS OF CONTROL DEVICE ELEMENTS OF SHIP HULL MECHANICAL STRESSES (p.17-21)

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The development of a control device of ship hull mechanical stresses during cargo and ballast operations based on a magnetometric method is proposed in the paper. The proposed method provides controlling mechanical stresses in real time, unambiguously connects elastic stresses with a controlled variable, i.e. a retentive magnetism. Herewith, the device, carrying out this method, is constructed on the basis of flux gates, making it simple and reliable in operation.

The estimation of metrological characteristics of the device elements controlling mechanical stresses of a ship hull was made. For this purpose, an experimental study of constituent elements of the device was conducted. For compensating the Earth magnetic field, it was suggested using an additional magnetometric channel. The obtained research results allow developing and manufacturing a commercial prototype of a fluxgate continuous monitoring device of ship hull mechanical stresses.

Keywords: ship hull, elastic stresses, retentive magnetism, flux gate, magnetometric channel

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NONDESTRUCTIVE TESTING AND DEFECTOSCOPY BASED ON THERMAL-IMAGING ACTIVE THERMOGRAPHY (p. 22-27)

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The possibility of identifying defects, based on thermoacoustic effects and their manifestation in the field of infrared radiation by methods of active thermography has been substantiated. The results of experimental researches of detecting defects and structural changes in the material of the object under study by the thermal-imaging control under the thermal and acoustic activated influence are given. The effectiveness of applying the proposed method of detecting defects is considered. The value of the conducted researches lies in the fact that the application of an activating external action

allows identifying the degradation of thermophysical properties of materials within a defective area, differentiating the origin of temperature anomalies and taking into account the effect of external parameters, which create false thermal anomalies under the thermal-imaging control. The developed method can be applied both in conditions of bench tests, and in cases of equipment materials remaining under the influence of process cyclic loadings.

Keywords: thermal, structural changes, acoustic thermography, infrared radiometry, nondestructive testing, thermal fields

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BASIC ELECTROPHYSICAL PARAMETERS OF $Ga_xIn_{1-x}As$ SOLID SOLUTION MICROWHISKERS (p. 27-33)

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The paper deals with the studying basic electrophysical parameters of $Ga_xIn_{1-x}As$ solid solution microwhiskers, grown by the method of chemical transport reactions using the vapor-liquid-crystal mechanism, and their stability under the influence of ionizing (neutron) radiation. Such studies are interesting in terms of the efficiency of the method of growing these materials, model calculations of their parameters and identifying possible application fields. The results of studying the electrophysical parameters (the Hall coefficient, resistivity, mobility) of the grown $Ga_xIn_{1-x}As$ microwhiskers in the composition range of $0.3 \leq x \leq 0.8$ are given. The band gap value of the microwhiskers was calculated by the changes behavior of the electrophysical parameters in the zone of intrinsic and mixed conduction. The analysis of the radiation resistance of the grown microwhiskers was carried out on the basis of the local electroneutrality level calculation for $Ga_xIn_{1-x}As$ solid solution with different composition and changes in the concentration of the intrinsic material charge carriers, determined before and after the neutron radiation at fluences of $F_n = 1 \cdot 10^{15} \text{ sm}^{-2}$ та $F_n = 7 \cdot 10^{15} \text{ sm}^{-2}$. It was found that in $Ga_xIn_{1-x}As$ solid solution the sublattices of binary compounds retain their properties and under the influence of ionizing radiation can compensate the material changes by forming radiation defects (dopants) of different types (acceptor and donor), which allow developing radiation-resistant devices on their basis. So, $Ga_xIn_{1-x}As$ solid solutions with the component composition of $x \leq 0.6$ are interesting in terms of using for sensors, operating in radiation conditions that was experimentally confirmed.

Keywords: microwhiskers, $Ga_xIn_{1-x}As$, electrophysical parameters, band gap value, radiation resistance.

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STUDY OF HYDROGEN-SATURATED SURFACES OF MULTICRYSTALLINE SILICON SUBSTRATES USING MASS SPECTROSCOPY METHODS (p. 34-37)

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Hydrogen-saturated surfaces of multicrystalline silicon substrates Baysix with porous silicon, used in the photoelectric converters production were studied using mass-spectrometry methods. Hydrogen saturation was carried out by electrochemical hydrogenation of porous silicon on p-type multicrystalline silicon substrates Baysix with resistivity $1...10 \text{ ohm}\cdot\text{sm}$. Comparison of multicrystalline silicon

samples surfaces was carried out before and after hydrogenation in the electrolyte, based on hydrofluoric acid, both in the secondary ions spectra and in the image of elements distribution on the surface (mode of ion microprobe and mass-spectral ion microscope). 2D-ion images of the multicrystalline substrate surface were obtained on the mass-spectrometer TOF5 SIMS using the current of hydrogen secondary ions H^+ and molecular SiH_2^+ . A number of samples were measured, depending on the electrochemical treatment time in the electrolyte. Analysis of hydrogenation modes, studied by the relative current intensity of the hydrogen secondary ions H^+ of the surface of multicrystalline silicon sample Baysix shows that hydrogenation turns into saturation after two hours of treatment. Dynamic etching mode on the mass-spectrometer TOF5 SIMS with determining the hydrogen amount from the surface deep into the studied sample shows that hydrogen concentration, determined by the intensity of secondary ions H^+ is higher on the surface and monotonously reduces deep into the sample.

Keywords: photoelectric converter, porous silicon, electrochemical hydrogenation, multicrystalline substrate, mass spectrometry.

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STUDY OF PHYSICAL AND MECHANICAL PROPERTIES OF SLEEVES SURFACES AFTER BROACHING (p. 38-40)

Valentine Bandura, Ruslan Budyak

Experimental studies of combined cutting broaching on steels 10 and 35 were conducted. Among the phase components of iron-carbon alloys, prone to plastic deformation, and thus to the texturization at a temperature, characteristic of broaching, there are solid solutions of carbon in iron - ferrite and austenite. Cementite as a chemical compound of iron and carbon is hard and brittle; therefore it is destroyed under large deformations. Pearlite as eutectoid mixture of ferrite and cementite is deformed due to the ferrite plates. Based on the foregoing, steels from the selected series, which have ferritic-pearlitic structure in the unhardened state are prone to the texturization at cutting broaching.

Texture formation and machined part surface hardening, related to this phenomenon, were proved, dependences of the texture grain inclination angle and microhardness were determined. The thickness of the layer, textured after cutting broaching is 0.2 mm. Thus, the thickness of further part surface hardening correlates well with the texture thickness. The friction coefficients values on the back surface of the cutting tool at broaching unhardened steels of the selected range are within 0.5 - 0.7. Previous cold hardening reduces these values approximately by half (to 0.2 - 0.35). Thus, the texturization intensity falls sharply. Hence, the scheme of the unit cell of broach "deforming element - two-three-tooth cutting section" is extremely promising in terms of the machined surface quality. Deforming-cutting broaching promotes the emergence of favorable tangential macroscopic stresses in the pipe shell surface layer.

Keywords: steel, cutting, broach, texture, hardening, microhardness, friction coefficient, cell, section.

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FORMATION OF CHROMIUM HYDRIDE IN CHROMIUM BEING ELECTRODEPOSITED ALLOYED WITH HYDROGEN (p. 41-44)

Oleg Girin, Igor Zakharov

The aim of the work is experimental verification of validity of the recently discovered phenomenon of phase formation through a stage of liquid state in metals being electrodeposited. The idea of the work is based on the known fact, that during crystallization of liquid phase of a transitional metal (e.g. chromium) alloyed in significant concentration with non-metal of minor atomic radius (e.g. hydrogen) intermediate phases with simple crystal lattices (e.g. hydrides) appear. Therefore, if in electrodeposited chromium alloyed with hydrogen the chromium hydride will be detected, this result will indicate validity of the phenomenon of phase formation through a stage of liquid state in metals being electrodeposited. To find the variants of chromium alloying with hydrogen during its electro-

deposition the method for estimation of the degree of hydrogen saturation of metals being electrodeposited is developed. Electrodeposition of chromium was accomplished in such conditions where the volume of hydrogen being formed on the cathode was 62700 times higher than the volume of chromium being formed, which indicated alloying of chromium during its electrodeposition with hydrogen in significant concentration. On the basis of the accomplished experiments the formation of chromium hydride during electrodeposition of chromium alloyed with hydrogen was found. The conclusion, that existence of intermediate phases in electrodeposited metals is a result of crystallization of liquid metallic phase being formed during electrochemical deposition of metals, was made. The obtained result proves the validity of the phenomenon of phase formation through a stage of liquid state in metals being electrodeposited.

Keywords: chromium hydride, chromium being electrodeposited, alloying, hydrogen, intermediate phase, electrodeposition

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CORROSION BEHAVIOR OF WELDED JOINTS IN OZONATED ACIDIC MEDIA (p. 45-48)

Galina Tatarchenko

The corrosion-electrochemical behavior of welded joints of steels and alloys, used as instrumental for organic synthesis processes in the presence of ozone was investigated. It was determined that welded joints in ozonated media are characterized by the increase in anodic current densities in the whole range of potentials and the shift of E_{cor} more negatively compared with the base metal that is associated with the decrease in active centers, on which ozone can be reduced.

In ozone synthesis conditions, the alloy 06XH28HDT can be recommended as a structural material for reactors manufacture. In the ozone oxidation processes, it is necessary to pay attention to welded joints, especially for stainless steels such as "18-10" as wide "cathodic loop" formation on polarization curves indicates their tendency to intergranular corrosion (IGC). Corrosion can also proceed in dangerous areas of pitting formation and repassivation of steels under the ozone action. Welded joints of ferritic stainless steels 08X17T show the tendency to IGC in periodical ozone syntheses that precludes the possibility of using welding sets or requires protection of joint.

Keywords: ozone, corrosion, welded joint, steel, acid, cathodic loop, reactor, synthesis.

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CALCULATION OF DISSIPATION FIELDS OF ROD DEFECTS OF SHORT-CIRCUITED ROTOR OF INDUCTION MOTOR (p. 49-52)

Tatyana Pobeda

Despite the long-term production of induction motors with short-circuited rotor, the technology of rotor casting with aluminum is still being improved and worked out. Information on the type of defect, its nature, location in the rod, as well as the

frequency of occurrence is valuable when making adjustments to the casting process.

The calculation model for the secondary electromagnetic field, caused by the change in the rotor rod parameters and the calculation model for the rotor rod electromagnetic field from the next rod influence are proposed in the paper. Such fields are usually analyzed by finding the vector magnetic potential values, which satisfy the Helmholtz and Laplace's equations, taking into account boundary conditions. The ratios for determining normal and tangential components of the electromagnetic field strength were obtained in the paper. Their use allows estimating the rotor rod thinning extent, choosing the optimum sensor height, as well as taking into account the influence of the near-located rods on each other. The diagrams, confirming the correctness of the obtained design ratios are given in the paper.

Keywords: defect, short-circuited rotor, vector potential, strength, dissipation field

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