ABSTRACT AND REFERENCES

APPLIED PHYSICS

MELTING TEMPERATURE CONTROL IN COEXTRUDING PROCESS (p. 3-5)

Vitaly Levanichev

Modern co-extrusion manufacturing of flexible multilayer polymeric packaging materials is considered as multiproduct and, in some cases, limited. Most readjustments require the change of feedstock composition. This affects the temperature profile of extruder, backpressure and requires prompt adjustment of technological modes.

The influence of technological parameters on the melting temperature in co-extrusion processes was studied. Investigations were carried out on 18 extruders, installed on 4 co-extrusion units with screw diameters from 25mm to 50mm, observations lasted for 1 month.

It is shown that the relative error of forecasting the melting temperature by mean temperature value in zones of extruder is ±12, 8% for the interval of ±2S. For more comprehensive analysis of heat exchange in extruder and the process control it was proposed to use the parameter - the percentage of heaters activation, which is standard for modern microprocessor temperature controllers.

Keywords: co-extrusion, melt temperature, forecasting, control.

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CALCULATION OF HYDRODYNAMIC INTERACTION IN SUPERFLUID LIQUID BY METHODS OF COMPUTATIONAL THEORY OF POTENTIAL (p. 6-10)

Iuliia Brazaluk

The problems of superfluid liquid hydrodynamics are quite relevant today. Previously uninvestigated problem of multiphase flow of superfluid liquid is considered in the paper. The tasks of streamline of groups of objects of different shapes by a flat stationary flow of superfluid liquid is formulated in terms of velocity potential in the form of differential equations in specific derived and boundary integral equations of potential theory. It was shown that for such a flow, the main force, affecting objects, is the strength of hydrodynamic interaction. Calculations were made using a standard algorithm for the boundary element method. The dependences of hydrodynamic interaction forces on the distance between the streamlined objects were obtained for circular and elliptical shaped objects. The cases of a large number of regularly situated circular objects were considered. It was shown that such a system is stable relating to perturbations along the flow velocity vector, and is unstable with respect to perturbations perpendicular to the vector. The considered problems illustrate the features of multiphase flow of superfluid liquid and can serve as model problems for studying such flows.

Keywords: superfluid liquid, cryogenic liquid, hydrodynamic interaction, boundary element method.

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EFFECT OF SURFACE TREATMENT OF WOOD ON THE FIRE RESISTANCE OF WOODEN STRUCTURES (p. 11-14)

Yuriy Tsapko

Flame spread during combustion of materials determines the intensity and dynamics of fire, depending on the effectiveness of the protection and the burn-up rate of building structures in the flame burning. A mathematical model of burn-up rate of wood. For obtaining analytical equation calculated burning rate of refractory material with the corresponding value of the indicator of slowing down. installations, the change of particular structure and properties of the contact zone of the wood, a layer of wood is characterized by resistance to external sources of energy (high flame), which suggests the protective nature of the wood surface modifiers. Stability of modified wood estimated to change the compressive strength of the average 3 times higher compared with the untreated wood structure burnup. Thus, treatment of wood helps to reduce the burn-up rate and thus increases the resistance of structures.

Keywords: impregnation, wood, fire retardants, preservatives, performance modifications, burning, fire wood, charring.

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INFLUENCE OF HIGH-TEMPERATURE DIFFUSION ANNEALING ON WEAR RESISTANCE OF PLASMA COATING TiC-Ni-Cr (p. 15-19)

Myroslav Kindrachuk, Aleksei Shevchenko, Oleksandr Bashta, Nataliia Ishchuk

The possibility of improving the quality of plasma coating of TiC-Ni-Cr system, deposited on titanium alloy (α+β), through high-temperature diffusion annealing is considered in the paper. Some results of researches in the field of tribology are given. The main objective of the research is improving physical, mechanical, tribological and technical properties of plasma coating of TiC-Ni-Cr system on titanium alloy Ti-5Al-5Mo-5V-1Fe-1Cr, using high-temperature diffusion annealing. When conducting researches a complex technique was used in the paper, which includes studying the composition, structure and properties of plasma coating and counterbodies using modern physical and chemical methods of analysis, and also determining their tribological properties in conditions of unlubricated sliding friction in the air. The given technology of improving plasma coating quality leads to wear reduction of coating and counterbody, allowing overall control of friction pair properties. The reason for increased wear resistance of plasma coating after high-temperature diffusion annealing is decreased fragility and increased ductility of structural components, as well as increased ability to form tribological structures. The research results can be applied by design engineers when designing various machine parts and mechanisms made of titanium alloys.

Keywords: wear resistance, plasma coating TiC-Ni-Cr, Ti-5Al-5Mo-5V-1Fe-1Cr, tribological properties, diffusion annealing.

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TECHNOLOGICAL ASPECTS OF CREATION OF NITRIDED DISCRETE COATINGS WITH USING LASER PROCESSING (p. 19-24)

Miroslav Kindrachuk, Nataliya Ischuk, Vladimir Pisarenko

The results of studying wear-resistant nitrided coatings of steels by combined laser and chemical-thermal processing are given in the paper. A new approach to design and formation of discrete nitrided coatings was formulated and implemented, based on purposeful use of structural-phase state of steels after previous laser treatment, which determines qualitative and quantitative changes in the nitrided layer. The regularities of the influence of previous laser processing in quenching and doping modes on phase and chemical composition, structure and properties of nitrided layers on steels were established. Increased solubility of nitrogen after laser treatment is the result of defect structure.

The influence of secondary structural heterogeneity of the surface, formed by discrete laser treatment, on wear resistance was investigated. It was established that previous laser processing significantly accelerates diffusion processes of nitriding, increases microhardness and changes phase composition compared with traditional nitriding methods. Experimental studies allowed establishing regularities of the influence of parameters of discrete structure, stress-strain state, surface nitrogen concentration, phase composition, microhardness of modified surface on its wear resistance. It is shown that discrete laser treatment improves wear resistance of steel 40X twice, continuous nitriding by 2.8 times and discrete nitriding by 5.6 times.

Keywords: hardening, discrete coatings, nitriding, laser, stress, structure, phase, wear resistance.

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CLASSIFICATION OF HETEROGENEOUS STRUCTURES AND CONDITIONS OF THEIR DOUBLY PERIODICITY (p. 24-29)

Stanislav Tolmachev, Stanislav Bondarevskiy

Despite a rather active interest in the theoretical and practical aspects of heterogeneous environment and structures (HES) – semiconductors, mixtures, solutions, reinforced and composite materials, magnetic filters, etc. – the scientific literature has not yet paid sufficient attention to the issue of their classification. This article partially makes up the deficiency suggesting, in particular, a possible classification of HES based on the difference between the geometric and physical parameters of the components, the scale of inclusions, etc. Special attention is paid to ordered (correct) HES with a doubly periodic structure, since they are components of many technological devices and materials. The article emphasizes the difference between the concepts "doubly lattice periods" and "doubly HES". Also, it illustrates the importance of identifying equivalent periods and gives of their equality relation; presents necessary and sufficient conditions of forming the global doubly periodic lattice by compiling a limited set of primitive doubly periodic lattices, and demonstrates when these conditions may be used for the synthesis of complex doubly periodic HES by combining correct HES of a lower level.

Keywords: doubly periodic structure, classification, period parallelogram, condition of doubly periodicity.

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PHYSICAL AND TECHNOLOGICAL ASPECTS OF MULTICHARGE IMPLANTATION OF GALLIUM ARSENIDE IN DEVICE AND CIRCUIT STRUCTURES (p. 29-36)

Stepan Novosyadlyy, Lubomyr Melnyk, Taras Kindrat

The development of microelectronics in Ukraine was accompanied by altering of four generations of ion implantation equipment. Nowadays, ion implantation devices of three classes of small and medium doses, high doses and high energies, are used for micro-, opto- and nanoelectronics. For many years, double-chamber "Vezuviy-3" and its modified version "Vezuviy-3M", with drum-type receiving units and electrostatic ion beam scanning, have been the most popular among light-dose devices. Despite its reasonable price, it has high efficiency (300 plates Ø76 mm per hour), high implantation heterogeneity (≤ 2% over a plate) and performance reliability (availability factor was ≥ 97%). High dose devices "Vezuviy-4" and "Vezuviy-8" of the 70-80s and their modified versions, with combined mechanical and electro-magnetic scanning, were produced using ion beam post-acceleration and receiving unit, which was both at high and ground potentials. The development of high-energy implantation was based on using multi-charge ions (2-4) of the main dopants. The energies below 2 MeB at total accelerating voltage 400 KeB and ion beam current p^{++} below 1mA and p^{+++} below 0,3 mA were recorded in one of modified versions of high-energy implantation "Vezuviy-9"›. It was the starting point of decreasing radiation defects in BIC structures.

Keywords: ion doping, multi-charge additives, semi-insulating gallium arsenide.

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SYSTEM FOR ACTIVATION OF METALS BY CYCLIC STRESSES AT THERMOGRAPHIC INSPECTION (p. 36-40)

Mykola Bazaleev, Boris Banduryan, Vasiliy Bryukhovetskiy, Vyacheslav Klepikov, Volodymyr Lytvynenko, Eugene Prokhorenko

The active thermographic method of construction materials inspection - thermodynamic thermal imaging inspection, which uses the energy of cyclic stresses for activation of thermal processes on irregularities and defects of solid bodies and their thermal development in the field of infrared radiation, is proposed. The method is based on the features of transformation of elastic waves energy into the heat on defect structures of solids, which are developed in the form of temperature anomalies on the surface and are sufficient to identify them with modern thermal imaging systems. For practical implementation of the method of thermodynamic thermal imaging inspection of materials, a scheme of the system was proposed, which provides the activation of thermal fields in the environment of controlled facility by applying cyclic stresses to it. Thermographic information on the state of facility is registered by technical means of thermal imaging control. The possibility of identifying microstructural irregularities and defects (cracks, flaws, inclusions) in metals under cyclic stresses of samples, with the help of modern thermal imaging means of thermal development control, was experimentally confirmed. Herewith, defects of material microstructure during absorbing the energy of elastic waves created thermal anomalies, the amplitude of which exceeded the background temperature value by 0, 4°C or more.

Keywords: infrared radiometry, inspection of solids, cyclic stresses.

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MEDICAL APPLICATION OF INNOVATIVE NUCLEAR TECHNOLOGIES (p. 41-43)

Vira Bondar

Heart and cancer-related diseases are considered to be one of the biggest problems of today's health world. Therefore, it is important to perform fundamental research of human tissues and external biological influence on these tissues, as well as develop and implement new innovative instruments of applied physics for diagnosis and treatment of heart and cancer diseases.

This paper presents overview of modern technical methods based on using ionizing radiation for medical purposes. In particular, new effective instruments of nuclear and high energy physics are considered in context of their implementation for the diagnosis and cancer treatment. Physical principles and main characteristics of PET imagining are discussed, as well as examples of successful implementation of protons (heavy ions) for the treatment are presented. A detailed overview of new advanced detector technologies and codes for modeling the processes of penetration of radiation with the matter is given. Perspective ideas of new nuclear instrumental technologies and methods are discussed. The problem of interconnection of fundamental research and bio-medical field is discusses, considering this as one of the obligatory conditions for successful implementation of new research instruments for advanced medical diagnosis technologies and treatment.

Keywords: Particle therapy; Positron-emission tomography (PET)

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DETECTION OF RADIO EAVESDROPPING DEVICES USING RADIOMETER (p. 44-48)

Igor Pilkevych, Volodimir Kotkov, Andrey Zavada, Sergey Overchuk

Analysis of the current state of combating industrial espionage causes the urgent need for creating new and improving the existing instruments for detecting radio eavesdropping devices.

The work is aimed at developing a method for detecting radio eavesdropping devices by their own electromagnetic radiation of thermal anomalies in dielectric media using a radiometer. The method of detecting radio eavesdropping devices lies in calculating thermal circuits and radiation intensity. Technical features of radiometer, providing practical application of the proposed method, were figured out in the paper.

As a result of the research, the method for detecting radio eavesdropping devices of various types was developed and a set of necessary technical parameters of radiometer, that will provide the measurement of thermal anomalies, was formulated. Simulation results showed that practical implementation of the developed method will allow detecting hidden radio eavesdropping devices at depths of up to 26cm with the size of absorbing medium skin-layer of about 0.1 cm.

Keywords: radiometer, radio thermal contrast, radio eavesdropping device, detection method, dielectric medium, thermal exchange.

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BLACK LIMIT. PART 12: THE TRANSFORMATION EXPANDED WITH LORENTSEVOYE (p. 48-55)

Sergey Yalovenko

Entered, new limitation – not a single body can not be dispersed to mass more than mass of black hole, in addition on limiting to velocity of light. On the base of this limitation new formulas for the theory of relativity and expansion of classic equalizations turn out for mass of, dliny, time. Relativity of charge is shown. Rasshiryayutsya formulas for a charge and gravitation. In this work continuation of theory of relativity is examined on the base of development of ether theory, where the discrete element of sverkhtekuchego ether is krepton (strong wave). Gde elementary particles are presented flat whirlpools, a gravitation is presented as a changing closeness of kreptona (strong wave). created flat whirlpools. A charge is presented however convolute the tail of sinewave stretched a whirlpool is in by a spiral and created. Energy of particles is presented as converting of forward energy of wave into rotatory energy of whirlpool. It is rotined that the gravitation of black hole is flat, but not circle. The star coefficient of refraction is shown out.

Keywords: theory of relativity, whirlpool, krepton, gravitation, closeness, mass, time, length, charge.

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