

Soviet Aerospace Literature

This month: *Mechanical Properties of Aerospace Materials*

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A87-17650 Anisotropy of the physicomechanical properties and endurance of a glass-reinforced plastic under thermal cycling (Anizotropiia fiziko-mekhanicheskikh svoistv i dolgovechnosti stekloplastika pri teplosmenakh) IU. S. PERVUSHIN and M. A. IVANOV, (Ufimskii Aviat-sionnyi Institut, Ufa, USSR) (Vsesoiuznaia Konferentsiia po Mekhanike Polimernykh i Kompozitnykh Materialov, 6th, Riga, Latvian SSR, Nov. 1986) *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), July-Aug. 1986, pp. 736-739. 8 refs.

An experimental study is made of the anisotropy of the physicomechanical properties and endurance of an orthogonally reinforced glass-fiber plastic (1:1) under thermal cycling with a varying stress ratio. On the basis of the experimental results obtained, the elastic moduli for specimens cut at 0, 45, and 90 degrees are calculated using the known formulas for the anisotropic body. It is shown that thermal cycling changes the anisotropy of the elastic properties and significantly reduces the endurance of the material.

Descriptors: *Elastic Anisotropy; *Glass Fiber Reinforced Plastics; *Mechanical Properties; *Physical Properties; *Thermal Cycling Tests; Modulus of Elasticity; Service Life

A87-28197 Possibilities for determining the properties of a monolayer in a composite (Vozmozhnosti opredeleniia svoistv monosloia v kompozite). N. A. ALFUTOV, L. P. TAIROVA.

IN: Methods and equipment for the diagnostics of the load-bearing capacity of composite parts (A87-28182 11-24). Riga, Izdatel'stvo Zinatne. 1986, pp. 212-215.

An approach to the determination of the characteristics of a monolayer from the properties of a stack of a specified number of layers is proposed, whereby a minimization algorithm is used to determine the monolayer characteristics that correspond to a minimum deviation between the predicted and experimentally determined properties of the stack. To demonstrate the approach, the elastic and strength characteristics of a monolayer of a carbon fiber composite, KMU-3I, are determined from test results for a sandwich composite with a honeycomb core and KMU-3I skins with various reinforcement patterns. It is shown that, even for a relatively small number of base characteristics, the approach proposed here makes it possible to improve agreement between theory and experiment for many reinforcement schemes.

Descriptors: *Carbon Fiber Reinforced Plastics; *Laminates; *Mechanical Properties; Composite Materials; Honeycomb Cores; Modulus of Elasticity; Optimization; Sandwich Structures; Stress Analysis

A86-23638 Determination of the thermophysical characteristics of polymer composite materials (K opredeleniiu teplofizicheskikh kharakteristik kompozitsionnykh polimernykh materialov) R. B. SENDEROVICH and IU. S. PERVUSHIN, (Ufimskii Aviat-sionnyi Institut, Ufa, USSR) *Inzhenerno-Fizicheskii Zhurnal* (ISSN 0021-0285), vol. 49, Dec. 1985, pp. 982-989. 17 refs.

A method is proposed for determining the temperature dependences of the thermophysical characteristics of polymer composites from measurements, in time, of the temperature fields at specified points on the specimens. The general design and the principle of operation of an experimental apparatus for conducting thermophysical and thermogravimetric measurements on polymer composites over a wide temperature range with programmed heating are described. Temperature dependences of thermophysical characteristics are presented for several kinds of fiber-glass composites, and a comparison is made with results obtained by the method of monotonic heating below the temperature of thermal degradation.

Descriptors: *Glass Fiber Reinforced Plastics; *Polymer Matrix Composites; *Polymer Physics; *Temperature Dependence; *Thermodynamic Properties; Measuring Instruments; Temperature Gradients; Temperature Measurement; Thermal Degradation; Thermogravimetry

A86-31238 The effect of the composition on the mechanical properties of a material based on silicon nitride (Vlianie sostava na mekhanicheskie svoistva materiala na osnove nitrida kremniia) G. A. GOGOTSI, IA. L. GRUSHEVSKII, N. N. ZUDIN, G. V. TRUNOV, and O. D. SHCHERBINA, (AN USSR, Institut Problem Materialovedeniia and Institut Problem Prochnosti, Kiev, Ukrainian SSR) *Poroshkovaia Metallurgiiia* (ISSN 0032-4795), Feb. 1986, pp. 93-96. 8 refs.

The composition of a silicon nitride ceramic is optimized by selecting the relative contents of the components of the initial charge. The composition of a three-component charge containing Si₃N₄ is selected using experimental design, with the principal strength characteristics of the materials used as the optimization factors. It is found that a ceramic material with optimal strength, deformability, and fracture toughness characteristics at normal temperature is obtained by using a mixture that does not contain silicon nitride; to obtain a material with optimal mechanical properties at 1400 C, the following charge composition is recommended: 50 pct Si₃N₄, 20 pct Si, and 30 pct SiC.

Descriptors: *Ceramics; *Chemical Composition; *Mechanical Properties; *Silicon Nitrides; *Sintering; Fracture Strength; Powder Metallurgy; Reaction Bonding; Ternary Systems

A87-13049 Cermets (Russian book) (Kermety) P. S. KISLYI, N. I. BODNARUK, M. S. BOROVIKOVA, O. V. ZAVERUKHA, and G. K. KOZINA, et al. Kiev, Izdatel'stvo Naukova Dumka, 1985, 272 pp. 516 refs.

The book is concerned with the physicochemical processes associated with the formation and binding of ceramic and metallic phases in cermets. In particular, attention is given to the molding, sintering, hot pressing, gasostatic compaction, and directional crystallization of oxide-metal, carbide-metal, nitride-metal, and boride-metal cermets. The discussion also covers methods used for studying the structure of cermets, problems of the testing and quality control of cermets, and their applications.

Descriptors: *Cermets; *Research and Development; Borides; Boron Carbides; Chemical Composition; Compacting; Crystallography; Directional Solidification (Crystals); Electron Microscopy; Hot Pressing; Metal Nitrides; Metal Oxides; Microstructure; Nondestructive Tests; Phase Transformations; Sintering; Thermodynamic Properties; Tungsten Carbides

A87-17463 The effect of oxidation on the strength and thermal stability of a material based on silicon nitride (Vlianie oksisleniia na prochnost' i termostoikost' materiala na osnove nitrida kremniia) V. A. LAVRENKO, A. A. CHERNOVLENKO, S. I. SOPENKO, V. I. ZUBOV, and A. F. ALEKSEEV, (Kievskii Politehnicheskii Institut, AN SSSR, Institut Problemy Prochnosti, Kiev, Ukrainian SSR); et al. *Problemy Prochnosti* (ISSN 0556-171X), Aug. 1986, pp. 67-70. 11 refs.

Results of a study of the effect of high-temperature oxidation on the strength and thermal stability of NKKKM-83a, a reaction-sintered material based on Si₃N₄-SiC (70:30), are presented. It is shown that oxidation in the range 800-1100 C decreases the room-temperature strength of the material but has no effect on its strength at 1200 C. Oxidation at 1300-1350 C increases the strength of the ceramic at both 20 and 1200 C; a further increase in oxidation temperature again produces a decrease in strength.

Descriptors: *Ceramics; *Mechanical Properties; *Oxidation Resistance; *Silicon Nitrides; *Thermal Stability; Temperature Dependence

A87-17464 The effect of the inhomogeneity of the thermal stressed state on the resistance of EI826 alloy to thermal fatigue (Vlianie neodnorodnosti termopriazhennogo sostoiianiia na soprotivlenie splava EI826 termicheskoi ustalosti) G. R. SEMENOV, (AN USSR, Institut Problemy Prochnosti, Kiev, Ukrainian SSR) *Problemy Prochnosti* (ISSN 0556-171X), Aug. 1986, pp. 71-75. 5 refs.

The thermal fatigue behavior of the high-temperature nickel-base alloy EI826 in a high-temperature gas flow is investigated experimentally using wedge-shaped specimens. The extent to which the inhomogeneity of the thermal stressed state, in particular a temperature gradient, affects the thermal cycling fatigue life of the alloy is determined.

Descriptors: *Heat Resistant Alloys; *Nickel Alloys; *Thermal Cycling Tests; *Thermal Fatigue; *Thermal Stability; Failure Analysis; Gas Temperature; Specimen Geometry; Temperature Gradients; Thermal Stresses

A87-25269 Beryllium in alloys (Russian book) Berillii v splavakh IGOR ISAKOVICH PAPIROV, Moscow, Energoatomizdat, 1986, 184 pp. 191 refs.

Results of studies of the structure, properties, and phase diagrams of more than 200 ternary and multicomponent beryllium-based alloys are presented in a systematic manner. Data are also presented for a series of alloys in which beryllium is used as an alloying element, including aluminum, cobalt, magnesium, molybdenum, and titanium alloys and steels. In addition to the structure, phase diagrams, and physicomechanical properties, the book covers heat treatments, mechanical working techniques, and applications.

Descriptors: *Beryllium Alloys; *Mechanical Properties; *Metallography; *Microstructure; *Phase Diagrams; *Ternary Alloys; Aluminum Alloys; Boron Alloys; Calcium; Carbon; Chromium Alloys; Cobalt Alloys; Copper Alloys; Germanium Alloys; Hydrogen; Iron Alloys; Magnesium Alloys; Niobium Alloys; Nitrogen; Silicon Alloys; Silver Alloys

A86-22528 The effect of thermal cycling treatment on the texture of alpha titanium alloys (Vlianie termotsiklicheskoii obrabotki na teksturu alpha-splavov titana) D. A. SKRIABIN and R. A. ADAMESKU, (Ural'skii Politehnicheskii Institut, Sverdlovsk, USSR) *Fizika Metallov i Metallovedeniia* (ISSN 0015-3230), vol. 60, Nov. 1985, pp. 955-959. 7 refs.

Experiments have been carried out on unalloyed titanium and a Ti-3.58 pct Al alloy to investigate the possibility of changing the texture of titanium alloy through thermal cycling. It is found that by multiple heating above and cooling below the polymorphic transition temperature, it is possible to obtain texture-free (small reduction) material or to substantially change the initial structure (large reduction). (V.L.)

Descriptors: *Heat Treatment; *Metal Crystals; *Phase Transformations; *Textures; *Thermal Cycling Tests; *Titanium Alloys; Aluminum Alloys; Hardness; Microstructure

A87-17465 The effect of protective coatings on the high-temperature fatigue of heat-resistant alloys (Vlianie zashchitnykh pokrytii na vysokotemperaturnuiu ustalost' zharoprochnykh splavov) I. U. VEKSLER, V. V. GRIBOV, V. P. LESNIKOV, A. A. RABINOVICH, and G. F. MIALNITSA, (Ural'skii Politehnicheskii Institut, Sverdlovsk, USSR); et al. *Problemy Prochnosti* (ISSN 0556-171X), Aug. 1986, pp. 76-78. 7 refs.

The fatigue properties of EP539LM alloy with an Al-Nb-Si fused slurry coating and a Co-Cr-Al-Y electron-beam coating are investigated experimentally in vacuum and in air at 900 C. It is found that the protective coatings reduce the fatigue life of the specimens both in vacuum and in air, with the electron-beam coating affecting the fatigue life of the alloy to a lesser degree than the fused slurry coating. The negative effect of the coatings on the fatigue life of the alloy is attributed largely to the properties of the coating material.

Descriptors: *Austenitic Stainless Steels; *Fatigue Tests; *Heat Resistant Alloys; *Protective Coatings; *Thermal Fatigue; Gas Turbine Engines; High Temperature; Thermal Vacuum Tests

A86-25407 Strength characteristics of profiled boron/aluminum composites (Prochnostnye kharakteristiki profilirovannykh boraliuminievykh kompositsii) R. M. AKHUNOV, B. L. BASKIN, V. V. PELLER, I. U. A. FADIN, and G. G. KHOKHLOV, (AN SSSR, Fiziko-Tekhnicheskii Institut, Leningrad, USSR) (Vsesoiuznoe Soveshchanie po Polucheniiu Profilirovannykh Kristallov i Izdelii Sposobom Stepanova i Ikh Primeneniiu v Narodnom Khoziaistve, Leningrad, USSR, Mar. 4-6, 1985) *Akademiia Nauk SSSR, Izvestiia, Seriya Fizicheskaiia* (ISSN 0367-6755), vol. 49, Dec. 1985, pp. 2447-2456. 9 refs.

Experiments have been carried out to investigate the possibility of using the Stepanov method for producing composite products consisting of an aluminum alloy (AD-1 and AMG-61) matrix reinforced with boron fibers as an inexpensive alternative to the traditional plasma-spraying and diffusion welding techniques. The properties of boron/aluminum composites grown by this method are examined with particular reference to the residual fiber strength, fiber-matrix adhesion, and temperature dependences of the rupture and shear strengths. Based on the results of the study, a low-cost process for the production of boron/aluminum profiles by the Stepanov method is proposed.

Descriptors: *Aluminum Alloys; *Aluminum Boron Composites; *Boron Reinforced Materials; *Mechanical Properties; *Metal Matrix Composites; Acoustic Emission; Crystal Growth; Fiber Strength; Low Cost; Production Engineering; Residual Strength; Shear Strength; Temperature Dependence

A87-25154 Thermal deformation and the high-temperature strength of composite materials (Teplovoe deformirovanie i prochnost' kompozitnykh materialov pri vysokikh temperaturakh) G. N. TRETIACHENKO and L. I. GRACHEVA, L. I. (AN USSR, Institut Problemy Prochnosti, Kiev, Ukrainian SSR) (Vsesoiuznaia Konferentsiia po Mekhanike Polimerov i Kompozitnykh Materialov, 6th, Riga, Latvian SSR, Nov. 1986) *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Sept.-Oct. 1986, pp. 800-805. 8 refs.

The thermodynamic relationships between specific heat and thermal expansion (compression) coefficient are examined for the case of nonmetallic degradable composites. For the uniaxial stressed state, a relationship is established between the temperature coefficient of linear expansion, alpha, and the elastic characteristics of composites. It is shown that the value of alpha depends not only on the composite structure but also on the composite fabrication process (e.g., heating conditions and the gas medium composition). It is further shown that, in the case of polymer and carbon composites subjected to purely thermal loading, the reliability of the calculated strength of composite structures increases as test conditions approach actual operating conditions.

Descriptors: *Composite Materials; *Thermal Expansion; *Thermal Stability; *Thermodynamic Properties; Elastic Properties; Polymer Matrix Composites; Specific Heat

A87-21656 High-temperature creep of powder-metallurgy nickel aluminide (Vysokotemperaturnaia polzuchest' poroshkovogo aluminida nikelia) S. M. BARINOV, P. V. ZUBAREV, V. S. IVANOV, and I. U. L. KRASULIN, *Akademiia Nauk SSSR, Izvestiia, Metally* (ISSN 0568-5303), Sept.-Oct. 1986, pp. 171-174. 11 refs.

It is shown experimentally that the steady-state creep rate of a PM NiAl alloy with a dispersion-strengthened structure formed by rapid powder compaction is about 1.5 order of magnitude less than that of a cast NiAl alloy. This is explained by the high stability of the dispersion-strengthened structure. The apparent activation enthalpy for the creep of PM NiAl is 560 kJ/mol at 1100-1200 C, which is attributed to processes occurring in the disperse grain-boundary oxide phase.

Descriptors: *Aluminum Alloys; *Creep Tests; *Intermetallics; *Nickel Alloys; *Powder Metallurgy; *Thermal Stresses; Enthalpy; Grain Boundaries; Strain Rate

A86-18159 A study of the effectiveness of protective coatings on ZhS6U alloy in thermal fatigue (Issledovanie effektivnosti zashchitnykh pokrytii na splave ZhS6U pri termicheskoi ustalosti) K. P. BUISIKH, (AN USSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR) *Problemy Prochnosti* (ISSN 0556-171X), Nov. 1985, pp. 52-57.

Experiments have been carried out to investigate the thermal fatigue behavior of ZhS6U high-temperature turbine alloy with slurry-diffusion and electron-beam vacuum-deposited coatings. The experimental data obtained illustrate the effect of the coating material and of the deposition process on the life of wedge-shaped specimens under conditions of thermal cycling in high-temperature gas flow. It is shown that a maximum protective effect is achieved at relatively low levels of thermal stress (approximately 0.3 of the 0.2-pct yield stress). Under these conditions, the fatigue life of the specimen increases by a factor of 5-6, 3.5, and 3 for multicomponent electron-beam coatings, and aluminide, and aluminosilicide coatings, respectively.

Descriptors: *Ferritic Stainless Steels; *Heat Resistant Alloys; *High Temperature Gases; *Protective Coatings; *Thermal Fatigue; Cyclic Loads; Electron Beams; Gas Turbines; Slurries; Specimen Geometry; Thermal Stresses; Vacuum Deposition; Wedges

A86-18970 The role of cobalt in high-temperature nickel alloys (Rol' koba'ta v nikel'evykh zharoprochnykh splavakh) K. I. A. SHPUNT, G. I. MOROZOVA, L. B. VASILENOK, V. A. VERTOGRADSKII, and L. S. EGOROVA, et al. *Akademii Nauk SSSR, Izvestiia, Metally* (ISSN 0568-5303), Nov.-Dec. 1985, pp. 100-108. 8 refs.

Experiments have been carried out on a series of induction-melted alloys of the system Ni-Co-Cr-Al-Ti-W-Mo-Nb-V, with Co content ranging from 0 to 15 percent, to determine the effect of cobalt on the high-temperature strength of nickel alloys. It is found that the highest heat resistance is achieved with a cobalt concentration of 8-10 percent. This effect of cobalt is due to an increased amount of the gamma-prime phase, a higher final temperature of gamma-prime dissolution, a higher solidus temperature, and a reduced diffusion permeability of the alloy. A further increase in cobalt content to 15 percent leads to the development of chemical inhomogeneity in the gamma-prime phase, a decrease in the solidus temperature, and an increase (approximately a factor of 2) in the self-diffusion rate of nickel atoms.

Descriptors: *Chemical Composition; *Cobalt Alloys; *Heat Resistant Alloys; *Microstructure; *Nickel Alloys; *Thermal Resistance; Dissolving; Face Centered Cubic Lattices; Induction Heating; Mechanical Properties; Solidus

A86-19285 Methods for the testing and analysis of light alloys: Handbook (Russian handbook) (Metody kontrolya i issledovaniia legkikh splavov: Spravochnik) I. U. M. VAINBLAT, ED. Moscow, *Izdatel'stvo Metallurgii*, 1985, 512 pp. 351 refs.

State-of-the-art methods for testing and analyzing the composition, structure, and mechanical and corrosion properties of light alloys are reviewed. In particular, attention is given to statistical processing of experimental results, analytical techniques for determining the composition of alloys, and methods for determining gas impurities in alloys. Various methods of structural studies are discussed in detail with reference to metallographic analysis, electron microscopy, analysis of chemical inhomogeneities, X-ray diffraction analysis, and fractographic studies. Finally, methods for determining the mechanical properties of aluminum, titanium, and magnesium alloys, as well as their corrosion and electrochemical properties are discussed, with attention given to nondestructive ultrasonic and eddy-current inspection techniques.

Descriptors: *Light Alloys; *Materials Tests; *Mechanical Properties; *Nondestructive Tests; Chemical Composition; Chemical Properties; Corrosion Resistance; Electric Current; Electrical Properties; Gas Composition; Metal-Gas Systems; Metallography; Metallurgy; Microstructure; Statistical Tests; Structural Engineering; Ultrasonic Flaw Detection

A87-20362 The structure and strength of layered and dispersion-strengthened films (Russian book) (Struktura i prochnost' sloistykh i dispersnouprochnennykh plenok) A. I. ILINSKII, Moscow, *Izdatel'stvo Metallurgii*, 1986, 144 pp. 208 refs.

Recent theoretical and experimental research related to the vacuum vapor deposition of composite metal and alloy foils (films) with high mechanical properties is reviewed with emphasis on the correlation between the process variables and the physicochemical and structural characteristics of the deposits. Methods for determining the mechanical properties of 1-100-micron films are presented, and the possibility of using high-strength composite coatings for improving the wear resistance and fatigue strength of metal components is discussed. The discussion is illustrated by results for Ag-Cu, Pb-Zn, Cu-SiO₂, Cu-Al₂O₃, and Ni-SiO₂ films.

Descriptors: *Ceramic Coatings; *Composite Materials; *Mechanical Properties; *Metal Films; *Precipitation Hardening; *Vacuum Deposition; High Strength Alloys; Metal Coatings; Metal Fatigue; Thin Films; Wear Resistance

A86-23685 An experimental study of the characteristics of deformation and fracture during the tension of cross-ply wound composites (Eksperimental'noe issledovanie osobennosti deformirovaniia i razrusheniia pri rastiazhenii perekrestno armirovannykh namotochnykh kompozitov) V. N. BULMANIS, I. U. I. GUSEV, A. S. STRUCHKOV, and V. B. ANTOKHONOV, (AN SSSR, IFTP Severa, Yakutsk, USSR; Vsesoiuznyi NII i PKIEMFD, Riga, Latvian SSR; Vostochno-Sibirskii Tekhnologicheskii Institut, Ulan-Ude, USSR) *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Nov.-Dec. 1985, pp. 1020-1024. 11 refs.

An experimental study is made of the effect of the width of the wound tape, the extent of tape interlacement, and the reinforcement coefficient on the deformation and strength characteristics of a cross-ply glass/epoxy composite wound at plus-minus 45 deg. It is shown that the tape width and the extent of interlacement do not affect the deformation behavior of the composite in the linear region. However, in the nonlinear region, an increase in the tape width, interlacement, and reinforcement coefficient results in a decrease of the composite strength.

Descriptors: *Composite Structures; *Filament Winding; *Glass Fiber Reinforced Plastics; *Mechanical Properties; *Tensile Tests; Epoxy Matrix Composites; Fabrication; Modulus of Elasticity; Width

A87-17710 Composite materials: Handbook (Russian book) (Kompozitsionnye materialy: Spravochnik) D. M. KARPINOS, ED. Kiev, *Izdatel'stvo Naukova Dumka*, 1985, 592 pp.

The book contains methods for calculating the physicochemical characteristics of composite materials and for determining the composition, structure, and properties of reinforced composites. Experimental data on interactions in the binary systems metal-metal and metal-refractory material are presented along with solutions to diffusion equations for the most typical cases of high-temperature interaction in composites reinforced with plate-like, cylindrical, and spherical inclusions. Other data include systematic information on the thermodynamic properties of high-melting compounds and data on the applications of reinforced, eutectic, and dispersion-strengthened composites and pseudo-alloys.

Descriptors: *Composite Materials; *Mechanical Properties; *Physical Properties; Aluminum Alloys; Compression Loads; Copper Alloys; Eutectic Composites; Iron Alloys; Magnesium Alloys; Metal Matrix Composites; Nickel Alloys; Polycrystals; Polymer Matrix Composites; Reinforcing Fibers; Single Crystals; Tensile Properties; Titanium Alloys

A87-26307 The effect of temperature, protective coatings, and service history on the fatigue strength of gas-turbine engine blades made from the high-temperature cast alloy EP539LM (Vliianie temperatury, zashchitnykh pokrytii i ekspluatatsionnoi naraботki na soprotivlenie ustalosti rabochikh lopatok GTD iz liteinogo zharoprochnogo splava EP539LM). V. I. ROMANOV, B. A. GRIAZNOV, A. A. RABINOVICH, O. G. ZHIRITSKII, and I. S. MALASHENKO (AN USSR, Institut Problem Prochnosti, Kiev, Ukrainian SSR), et al. *Problemy Prochnosti* (ISSN 0556-171X), Nov. 1986, p. 47-52.

A procedure for the fatigue testing of the blades of gas-turbine engines at high temperatures and loading frequencies is described with particular reference to blades made from the high-temperature cast alloy EP539LM with various protective coatings. The heating of test specimens is done by high-frequency current; mechanical loading is carried out using an electrodynamic excitation and high-Q oscillatory systems. It is shown that, as a rule, protective coatings somewhat reduce the fatigue strength of the alloy, with the exception of slurry-diffusion Al-Si coatings. Optimum overall protection, however, is provided by a multicomponent electron-beam Co-Cr-Al-Y coating.

Descriptors: *Fatigue Life; *Gas Turbine Engines; *Heat Resistant Alloys; *Protective Coatings; *Temperature Effects; *Turbine Blades; Cast Alloys; Corrosion Resistance; Mechanical Properties; Thermal Stresses

A87-17479 Thermal conductivity of multilayer composite insulations based on ZrO₂ and ZrC (Teploprovodnost' kompozitsionnykh mnogosloinykh izoliatsii na osnove ZrO₂ i ZrC) S. M. KATS, V. N. BOGIN, A. M. MOISEEV, S. S. ORDANIAN, and T. S. BASALAEVA, (Leningradskii Tekhnologicheskii Institut, Leningrad, USSR) *Teplofizika Vysokikh Temperatur* (ISSN 0040-3644), vol. 24, July-Aug. 1986, p. 705-709. 10 refs.

The thermal conductivity of multilayer composites consisting of alternating layers of zirconium oxide and carbide, ZrO₂/ZrC, or a zirconium carbide-oxide cermet and pure zirconium carbide, (ZrO₂-ZrC)/ZrC, is investigated in the temperature range 1100-2000 K using the method of stationary radial heat flux through the specimen wall. It is found that while the thermal conductivity of porous ZrO₂/ZrC composites is comparable to that of pure nonporous ZrO₂, the high-temperature mechanical properties of the composites are significantly better due to the presence of carbide layers. The thermal insulation properties of the (ZrO₂-ZrC)/ZrC composites are somewhat lower than those of the ZrO₂/ZrC composites, but the cermet-based composites have superior high-temperature mechanical properties.

Descriptors: *Cermets *Conductive Heat Transfer; *Laminates; *Thermal Insulation; *Zirconium Compounds; Temperature Profiles; Thermal Conductivity; Zirconium Carbides; Zirconium Oxides

A87-24460 Thermophysical properties of a copper-graphite material at high temperatures (Teplofizicheskie svoystva mednografyrovogo materiala pri vysokikh temperaturakh) A. N. KVASHA, O. N. SEMCHENKO, S. K. SENOTRUSOV, K. M. KONSTANTINOV, and O. P. ZHELEZNIAK, (*Dnepropetrovskii Gosudarstvennyi Universitet, Dnepropetrovsk, Ukrainian SSR*) *Teplofizika Vysokikh Temperatur* (ISSN 0040-3644), vol. 24, Sept.-Oct. 1986, pp. 1029-1031. 5 refs.

A study is made of the thermophysical properties of a high-density (6.4 g/cu cm) sintered antifriction material based on PMS-2 copper powder with 10 percent of S-2 colloid graphite. It is shown that the final structure of the sintered material is a heterogeneous system with interdiffused components and closed inclusions. The existing generalized conductivity equations make it possible to calculate the effective thermal conductivity of the antifriction material in the temperature range 20-800 C with an accuracy to within plus or minus 20 percent.

Descriptors: *Cermets; *Copper; *Graphite; *High Temperature Tests; *Sintering; *Thermophysical Properties; Metal Powder; Microstructure; Temperature Profiles; Thermal Conductivity

A86-44739 The effect of oxidation on the strength of a reaction-sintered silicon nitride ceramic (Vlianie oksleniia na prochnost' reaktionospechennoi keramiki na osnove nitrda kremniia) I. U. G. GOGOTSI, A. G. GOGOTSI, and O. D. SHCHERBINA, (*Kievskii Politekhnikeskii Institut, Kiev, Ukrainian SSR*) *Poroshkovaia Metallurgii* (ISSN 0032-4795), May 1986, pp. 40-44. 13 refs.

An experimental study is made of the effect of oxidation with subsequent removal of the oxidized layer on the strength of a reaction-sintered material based on Si₃N₄-SiC at 20 and 1400 C. It is found that the oxidizing treatment increases the strength of the material at 20 C by 20 percent while reducing its short-term strength at 1400 C in comparison with nonoxidized specimens. The increase in strength at 20 C is mainly due to the healing of defects in the surface layers and refinement of the internal layers; the decrease in strength at 1400 C may be due to the generation of internal stresses.

Descriptors: *Ceramics; *Oxidation; *Reaction Bonding; *Silicon Nitrides; *Sintering; *Thermal Resistance; Crystal Defects; Mechanical Properties; Residual Stress; Surface Layers

A87-21667 Fracture of ceramic materials under local thermal loading (Razrushenie keramicheskikh materialov pri lokal'nom termicheskoi nagruzhении) A. G. LANIN, V. P. POPOV, V. S. KOLESOV, and N. A. BOCHKOV, *Problemy Prochnosti* (ISSN 0556-171X), Sept. 1986, pp. 35-38. 8 refs.

An experimental study is made of the fracture behavior of 24 x 2.4-mm disks of ZrCo-93 under local axisymmetric heating by an electron beam. The heat flux is determined experimentally from the electric parameters of the beam with an accuracy to within plus or minus 10 percent; the moment of fracture is recorded when the electric circuit through the specimen is broken. By solving the thermoelastic problem for a finite cylinder by the initial function method, the fracture behavior of zirconium carbide is characterized as a function of the type and inhomogeneity of the stressed state of the specimen in the loading time range 0.1-0.001 s.

Descriptors: *CERAMICS; *Fracture Mechanics; *High Temperature Tests; *Thermal Stresses; *Thermoelasticity; *Zirconium Carbides; Cylindrical Bodies; Electron Beams; Stress Concentration; Temperature Dependence; Time Dependence

A87-24399 Multilayer metal-oxide composites based on cast plasticized films with powder fillers (Mnogosloinnye metallo-oksidnye kompozity na osnove litykh plastifitsirovannykh plenok s poroshkovymi napolniteliami) S. M. KATS, V. N. BOGIN, S. S. ORDANIAN, T. S. BASALAEVA, and N. G. CHUBENKO, (*Leningradskii Tekhnologicheskii Institut, Leningrad, USSR*) *Poroshkovaia Metallurgii* (ISSN 0032-4795), Oct. 1986, pp. 71-78. 9 refs.

Some aspects of the production of multilayer composites by the film casting technique are examined, as are possible applications of such materials. A study is then made of the physicomechanical properties (e.g., flexural strength, elastic modulus, brittleness, and heat conductivity) of some multilayer metal oxide composites, including Al₂O₃-Mo, ZrO₂-W, ZrO₂-Mo, and Y₂O₃-W. The stability of metal-oxide composites against oxidation is discussed.

Descriptors: *Cermets; *Composite Materials; *Mechanical Properties; *Metal Oxides; *Refractory Metal Alloys; Brittleness; Conductive Heat Transfer; Modules of Elasticity; Molybdenum; Tungsten; Zirconium Oxides

A86-27574 The temperature dependence of the yield stress of dispersion-hardened composite films (Temperaturnaia zavisimost' napriazheniia techeniia plenochnykh dispersno-uprochnennykh kompozitsii) A. I. ILINSKII, G. E. LIAKH, I. A. SAVCHENKO, and A. S. TERLET-SKII, (*Khar'kovskii Politekhnikeskii Institut, Kharkov, Ukrainian SSR*) *Metallofizika* (ISSN 0204-3580), vol. 8, Jan.-Feb. 1986, pp. 104-108, 119. 16 refs.

Results of a study of the mechanical properties of dispersion-hardened Ni-SiO and Cu-Al₂O₃ composites produced by vacuum vapor deposition are reported. In particular, attention is given to the effect of the hardening phase concentration on the mechanical properties and to the temperature dependences of the proportionality limit of the composites. It is shown that the structure of the composites remains stable as the test temperature increases and that changes in the proportionality limit are due to a transition from the Orowan mechanism to a diffusion-controlled dislocation-climb mechanism.

Descriptors: *Composite Materials; *High Temperature Tests; *Metal Films; *Oxide Films; *Precipitation Hardening; *Yield Point; Copper Alloys; Crystal Dislocations; Mechanical Properties; Metal Foils; Nickel Alloys; Proportional Limit; Vacuum Deposition

A87-17979 Internal stresses and microplasticity of sintered powder alloys (Vnutrennie napriazheniia i mikroplastichnost' spechennykh poroshkovykh spлавov) V. A. CHELNOKOV, V. I. MONIN, and N. L. KUZMIN, (*Leningradskii Politekhnikeskii Institut, Trudy*) (ISSN 0376-1304), no. 408, 1985, pp. 3-7. 5 refs.

Microplasticity processes in sintered Al-matrix-based composites, SAS1-50 and SAS1-globular, were investigated using X-ray structural analysis and internal friction methods. The temperature-internal friction plots obtained for materials annealed at 500 C and cooled down to -196 C have disclosed peaks related to the energy dissipated during the opening and closing of cracks induced by thermal interphase stresses. The amplitude decrement plots obtained for the SAS1-50 sample after thermal treatment have disclosed the presence of a cleavage in the principal peak.

Descriptors: *Aluminum Alloys; *Plastic Properties; *Residual Stress; *Sintered Aluminum Powder; *Thermal Stresses; Crack Closure; Crack Initiation; Heat Treatment; Internal Friction; X Ray Analysis

A87-28186 Strength diagnostics of unidirectional composites based on the results of semidestructive tests (Dagnostika prochnosti odnonapravlennykh kompozitov po rezul'tatam polurazrushaiushchikh ispytani) V. P. TAMUZH, V. P.

IN: Methods and equipment for the diagnostics of the load-bearing capacity of composite parts (A87-28182 11-24). *Riga, Izdatel'stvo Zinatne*. 1986, pp. 42-50. 8 refs.

A method is proposed for evaluating the mean strength and strength dispersion as well as the scale dependence of strength and damage limit for unidirectional fiber composites on the basis of the strength and deformability characteristics of the fibers, with allowance for the effect of fiber-matrix debonding during fracture. A method is also presented for determining the strength characteristics of fibers from an integral acoustic emission curve obtained under tensile loading of a composite. Results obtained for a carbon-fiber composite are in good agreement with control test data. Descriptors: *Carbon Fiber Reinforced Plastics; *Destructive Tests; *Fiber Orientation; *Mechanical Properties; *Stress Analysis; Acoustic Emission; Cumulative Damage; Fiber Strength; Fracture Mechanics; Tensile Tests

A87-28456 A study of the fine structure of plate colonies in VT6 titanium alloy (Issledovanie tonkogo stroeniia plastinchatykh struktur titanovogo splava tipa VT6) A. A. BABAREKO, O. S. BELOVA, and G. V. MEDVEDEVA, (*Akademiia Nauk SSSR, Izvestiia, Metally*) (ISSN 0568-5303), Nov.-Dec. 1986, pp. 142-148.

The structure of slowly cooled cast specimens of a pseudo-alpha Ti-Al-V alloy, VT6, with a plate-like alpha phase (plate colonies up to 5-10 mm) is investigated experimentally using the method of structural component coloration in conjunction with optical microscopy and the Laue method. It is shown that plate colonies, with a difference in crystalline orientation up to 90 deg between adjacent colonies, are formed during the beta-alpha transformation. The multilevel morphologically and crystallogometrically complex structure of the transformed beta phase is explained by the multivariant nature of the first and second homogeneous shears forming the Guinier-Preston phase during the beta-alpha (alpha prime) transformation.

Descriptors: *Fine Structure; *Lamella (Metallurgy); *Mechanical Properties; *Metal Crystals; *Phase Transformations; *Titanium Alloys; Aluminum Alloys; Close Packed Lattices; Crystallography; Hexagonal Cells; and Vanadium Alloys