

Soviet Aerospace Literature

This month: *Composite Materials and Structures*

Throughout 1988 the *AIAA Journal* will carry selected abstracts on leading research topics from the Soviet aerospace literature. The topics will be chosen and the abstracts reviewed for pertinency by *AIAA Journal* editors. This month features composite materials and structures.

Support for assembling and publishing the selected abstracts has been provided by the Innovative Science and Technology Directorate of the Strategic Defense Initiative Organization (SDIO), with the sponsorship and technical management of the abstract service by the Office of Naval Research (ONR) under ONR Grant N0014-87-6-0137.

Abstracts in this listing have been taken from the semimonthly abstract journal International Aerospace Abstracts (IAA), published by the American Institute of Aeronautics and Astronautics (AIAA) in cooperation with the National Aeronautics and Space Administration (NASA) under Contract No. NASW-4112. Additional material can be obtained through searching the Aerospace Database – available online via DIALOG or NASA RECON.

Paper copies and microfiche of the original documents cited are available from AIAA Library, Technical Information Service, American Institute of Aeronautics and Astronautics, Inc., 555 W. 57th St., New York, NY 10019 (212) 247-6500, ext. 231. Use the "A" number to identify material you want. Please be advised that the original documents are in Russian. Direct questions concerning this abstract section of the *AIAA Journal* to John Newbauer, AIAA Administrator, Technical Publications.

A88-18028 Extent of interphase physicochemical interaction and shear strength of fiber metal composites (Stepen' razvitiia mezhfaznogo fiziko-khimicheskogo vzaimodeistviia i prochnost' na sdvig voloknistykh metallokompozitov). L. E. GUKASIAN, *Fizika i Khimiia Obrabotki Materialov* (ISSN 0015-3214), Sept.-Oct. 1987, pp. 94-99. 10 Refs.

A method is proposed for estimating the extent of interphase physicochemical interaction in fiber-reinforced metal-matrix composites with a homogeneous interface. It is shown that the shear strength of fiber composites increases with the extent of interphase physicochemical interaction, which is characterized by the strength of the bond between the components. When estimating the extent of interphase interaction through shear tests, it is important that the loading scheme be taken into account since interlayer and intralayer shear may produce different results.

A88-17872 Performance of polymer composite structures under the effect of static loads and climatic factors (Rabotosposobnost' konstruktov iz polimernykh kompozitov pri vozdeistvii staticheskikh nagruzok i klimaticeskikh faktorov). V. N. BULMANIS, V. A. IARTSEV, and V. V. KRIVONOS, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Sept.-Oct. 1987, pp. 915-920.

A phenomenological model for predicting the life of composite structures is proposed which uses the hypothesis of the self-similarity of the damage accumulation process and assumes the applicability of the superposition principle for functions describing force and climatic effects. The specific effect of static loads on the life of composite structures exposed to environmental effects and the noninformative nature of residual strength characteristics are demonstrated. The model is validated using an orthogonally reinforced carbon composite loaded in bending.

A88-17874 A method for estimating the fracture toughness of composite materials in the case of delamination (Metodika otsenki viazkosti razrusheniia pri rassloenii kompozitnykh materialov). L. I. PIATYKHIN and A. G. VAL'KO, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Sept.-Oct. 1987, pp. 935-937. 5 Refs.

A method is proposed for estimating the fracture toughness of thin-layer composite laminates which fracture at the interface. The method is verified experimentally for a model layered composite consisting of aluminum alloy and adhesive polyethylene layers; the fracture toughness is calculated using the Cherepanov-Rice integral. The applicability limits of the method are determined.

A88-17873 A unified set of experimental and computational aids for studying the dynamic characteristics of composite materials (Edinyi kompleks eksperimental'nykh i vychislitel'nykh sredstv dlia issledovaniia dinamicheskikh kharakteristik kompozitnykh materialov). I. P. KRASNOSHCHIEKOV and V. P. MUZYCHENKO, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Sept.-Oct. 1987, pp. 921-925. 17 Refs.

A unified set of instruments, test stands, experimental methods, and software has been put together for the a posteriori processing of test results. The methodological base of the system includes the recently developed nonstationary rod method, modified composite Hopkinson rod method, and a relaxation test method. All three methods provide information on the hereditary properties of materials. A block diagram of the system is presented.

A88-17875 A model of interaction between defects during the fracture of a unidirectional composite (Model' vzaimodeistviia defektov pri razrushenii odnonapravlenogo kompozita). I. U. A. GUTANS and P. E. PIKSHE, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Sept.-Oct. 1987, pp. 937-940. 10 Refs.

The effect of interaction between defects on the strength of a unidirectional composite under axial tensile loading is investigated analytically. It is shown that consideration of defect interaction leads to lower estimates of the composite strength. It is further shown that the composite strength decreases with the degree of disperse damage, fiber variability coefficient, and material volume.

A88-17871 Technological problems in the mechanics of composite structures (Tekhnologicheskie zadachi mekhaniki konstruktov iz kompozitnykh materialov). V. L. BLAGONADEZHIN, A. N. VORONTSOV, and G. KH. MURZAKHANOV, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Sept.-Oct. 1987, pp. 859-877. 126 Refs.

Recent theoretical and experimental research related to technological problems in the mechanics of filament-wound and extruded composite materials and structures is reviewed. Particular attention is given to the history of the development of mechanical models describing the effect of technological factors on the stressed state and structure of semi-finished products. The current status of applied composite mechanics is examined with reference to specific applications. Finally, some areas of future research are defined.

A88-17870 Optimization of stiffened cylindrical composite shell structures (Optimizatsiia konstrukttsii podkreplennykh tsilindricheskikh obolochek iz kompozitov). V. T. TOMASHEVSKII, A. P. ANUFRIEV, V. N. SHALYGIN, V. S. IAKOVLEV, and R. I. KALIMULIN, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Sept.-Oct. 1987, pp. 853-858.

The paper is concerned with the optimum design of composite cylindrical shells stiffened by a longitudinal-transverse set of ribs subjected to loading by an axial compressive force or external pressure. An algorithm for finding the optimum shell stiffening and winding parameters is constructed using the method of combinatorial-heuristic optimization. The constraints examined include load-bearing constraints and natural structural and technological constraints.

A88-13747 Determination of coefficients in tensor-polynomial fracture criteria (K voprosu opredeleniia koefitsientov v tenzorno-polinomial'nykh kriteriakh razrusheniia). E. V. MESHKOV, V. I. KULIK, Z. T. UPITIS, and R. B. RIKARDS, *Problemy Prochnosti* (ISSN 0556-171X), Sept. 1987, pp. 66-72. 23 Refs.

Two principal approaches to the determination of coefficients in tensor-polynomial fracture criteria for anisotropic materials are analyzed, and a third criterion is proposed which is based on the partial optimization of the coefficients by the least squares method. The effectiveness of the approach proposed here is verified experimentally for glass and organic fiber composites under plane strain conditions. The optimal number of tests is determined and specific loading schemes are recommended.

A88-17867 Deformation and fracture of two-layer metal-plastic shells under internal impulsive loading (Deformatsiia i razrushenie dvukhsloinykh metalloplastikovyykh obolochek pri vnutrennem impul'snom nagruzhении). V. I. TSYPKIN, V. N. RUSAK, A. G. IVANOV, A. G. FEDORENKO, and O. S. VORONTSOVA, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Sept.-Oct. 1987, pp. 833-838. 6 Refs.

Experimental data are presented on the deformation and fracture behavior of cylindrical two-layer shells with FGFRP and steel 20 layers of varying thickness under internal impulsive loading. It is shown that the principal parameters of the dynamic deformation of the two-layer shells are determined by the properties of the glass-fiber composite. The results emphasize the advantages of using combined metal-plastic shells in thin-walled structures under conditions of extreme impulsive loads.

A88-17862 Creep of fiber polymer composites in structures (Polzuchest' voloknistykh polimernykh kompozitov v konstrukttsiakh). N. I. MALININ, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Sept.-Oct. 1987, pp. 797-802. 10 Refs.

The load-bearing capacity of wound organic-fiber composite shells is estimated with particular reference to the contributions of the tape stiffness in the direction transverse to the fibers and of the Poisson ratio. The estimates indicate that these contributions are negligibly small. It is suggested that the problem concerning tape creep in wound composite shells be treated as a one-dimensional problem, with only longitudinal creep of the tape taken into account.

A88-14672 Modeling of matrix deformation during the compaction of fiber composite materials (Modellirovanie deformatsii matritsy pri kompaktirovani voloknistykh kompozitsionnykh materialov). B. A. AREF'EV, N. V. BIBA, E. V. SUSLOVA, and I. V. MAKSIMCHUK, *Akademiia Nauk SSSR, Izvestiia, Metally* (ISSN 0568-5303), Sept.-Oct. 1987, pp. 107-111. 9 Refs.

The problem of the viscoplastic flow of the matrix material during the compaction of fiber composites with a metal matrix is solved numerically using a finite element algorithm. Velocity, stress, and strain fields in the matrix material, as well as contact stresses and deformation forces, are calculated for different moments of time during the compaction process. A comparison of calculations for the compaction of an aluminum-matrix fiber composite at 450 C with experimental results demonstrates the validity of the mathematical model developed here.

A88-13748 A study of the active and repeat loading of a reinforced polymer material at elevated temperatures (Issledovanie protsessov aktivnogo i povtornogo nagruzheniia polimernogo armirovannogo materiala pri povyshennoi temperature). M. E. BABESHKO and R. G. TEREKHOV, *Problemy Prochnosti* (ISSN 0556-171X), Sept. 1987, pp. 73-76. 5 Refs.

The processes of the active and repeat uniaxial isothermal and nonisothermal loading of a reinforced plastic, whose properties depend to a large degree on the time of its exposure to elevated temperatures, are investigated in the context of the nonlinear theory of a hereditary medium. The nonlinear governing equation with Abel's kernel contains two parameters that are calculated from instantaneous stress-strain diagrams for several holding times at given temperatures and creep diagrams for the same temperatures. The results obtained by this approach are compared with experimental data.

A88-12083 Scientific fundamentals and problems of the technological mechanics of composite structures (Nauchnye osnovy i problemy tekhnologicheskoi mekhaniki konstrukttsii iz kompozitnykh materialov). I. F. OBRAZTSOV and V. T. TOMASHEVSKII, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), July-Aug. 1987, pp. 671-699. 31 Refs.

The general problems considered within the scope of technological mechanics are reviewed with particular reference to composite structures. Attention is given to a system of mathematical models of physicochemical and mechanical phenomena associated with composite fabrication processes, including models of heat conductivity, kinetics of structural transformations in the matrix, kinetics of changes in the thermophysical and physicochemical properties of the components, and evolution of the stress-strain state during the fabrication of composites. The problems discussed include modeling of the conditions leading to the formation of macrostructural defects during the fabrication and processing of composites, modeling and quantitative analysis of the effect of processing history on the performance of composite structures, and control of the quality of composite structures during their fabrication.

A88-12078 Heat conductivity of fiber composites and their components (Teploprovodnost' voloknistogo kompozita i ego sostavliashchikh). A. F. KREGERS, I. A. REPELIS, and A. M. TOLKS, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), July-Aug. 1987, pp. 604-608. 7 Refs.

Independent heat conductivity coefficients are determined experimentally for ten different fiber-reinforced composite materials. All the composites investigated have an ED-20 epoxy matrix, whose heat conductivity coefficient is also determined experimentally. The experimental results have been used to test a computational model based on orientation averaging methods.

A88-17864 Effect of prolonged exposure to extreme conditions on the properties of prestressed composites in tension, compression, and creep (Vliianie dlitel'nogo vozdeistviia ekstremal'nykh uslovii na svoistva predvaritel'no nagruzhennykh kompozitov pri rastiazhenii, szhatii i sdvige). I. G. ZHIGUN, I. N. IVONIN, R. P. SHLITSA, and E. F. NIKISHIN, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Sept.-Oct. 1987, pp. 813-818. 9 Refs.

The effect of prolonged exposure to extreme conditions (e.g., space environment) on the elastic properties of glass- and carbon-fiber composites that have been prestressed under tension, compression, or creep, is investigated experimentally. The results obtained are compared with those obtained for control specimens under normal room-temperature conditions. Specimens of glass fiber composites prestressed in compression (up to one third of the compressive strength) are found to be sensitive to the effect of space environment, with prolonged exposure leading to a decrease in strength and interlayer shear modulus. In the case of glass- and carbon-fiber composite prestressed in tension, the sensitivity to extreme conditions is low.

A88-11349 Production of oxide-metal P/M composites using pulsed plasma heating (Polychenie granulirovannykh kompozitsionnykh materialov oksid-metal' pri impul'snom plazmennom nagreve). I. V. BLINKOV, A. V. MANUKHIN, A. O. OSTAPOVICH, and I. A. PAVLOV, *Poroshkovaia Metallurgii* (ISSN 0032-4795), Aug. 1987, pp. 48-52. 7 Refs.

The possibility of producing oxide-metal P/M composites using plasma generated by a pulsed discharge is investigated experimentally for the system Al₂O₃-Ni. It is found that Al₂O₃ metallization in plasma is accompanied by spheroidization; changes in the physicochemical properties of the Al₂O₃-Ni composite during plasma treatment are examined. The characteristic features of the process associated with the effect of pulsed energy on the disperse flow of the oxide-metal mixture are discussed.

A88-11348 A theoretical and experimental study of the plastic deformation of sintered composites. I - An analysis of the conditions of the simultaneous deformation of heterogeneous composite phases (Teoreticheskoe i eksperimental'noe issledovanie protsessov plasticheskoi deformatsii spechennykh kompozitsionnykh materialov. I - Analiz uslovii sovmestnoi deformatsii raznorodnykh faz kompozitsionnogo materiala). S. S. IPARISOV, I. A. KILANSKII, and V. E. PEREL'MAN, *Poroshkovaia Metallurgii* (ISSN 0032-4795), Aug. 1987, pp. 17-23. 6 Refs.

The conditions of the simultaneous deformation of the heterogeneous phases of a composite material with essentially different strength characteristics are analyzed using the concepts of mechanics. The dependence of the shear stress on the compressive stress is demonstrated, and it is shown that the extent of this dependence is largely determined by the ratio of the strength characteristics of the components of the composite, phase contact area per unit volume, and relative orientation of property discontinuity surfaces and slip planes. The possibility of increasing the shear strength of a composite to that of the harder phase is demonstrated experimentally for Cu-Nb and Al-Nb composites.

A87-50848 Effect of various factors on the temperature field during the quasi-stationary heating of materials (Vlianie razlichnykh faktorov na temperaturnoe pole pri kvazistatsionarnom rezhime nagreva materialov). K. B. ISAEV, *Promyshlennaya Teplofizika* (ISSN 0204-3602), Vol. 9, no. 3, 1987, pp. 39-43. 6 Refs.

The nonlinear heat conductivity problem of the stationary fracture under conditions of quasi-stationary heating of a material is solved analytically with allowance for internal heat sinks (sources) for arbitrary temperature dependences of the thermophysical characteristics. The effect of various factors on the accuracy of temperature field calculations in the case of stationary fracture is discussed with reference to results obtained for glass-reinforced plastics.

A87-50899 The role of a zirconium carbide coating in the stabilization of the fiber-matrix interface in a chromium composite (Rol' pokrytiia karbida tsirkoniia v stabilizatsii granitsy razdela volokno-matritsa v khromovoi kompozitsii). D. M. KARPINOS, V. N. BALAKHININA, S. P. LISTOVNICHAI, and V. B. VOITOVICH, *Fizika i Khimiia Obrabotki Materialov* (ISSN 0015-3214), May-June 1987, pp. 108-113. 8 Refs.

A study is made of the compatibility between the structural components in a chromium-matrix composite reinforced by ZrC-coated tungsten fibers. The structure and the phase composition of the interaction zone and element distribution in the fiber cross section after forming and heat treatment are determined. It is shown that single-phase dense coatings of zirconium carbide are characterized by a limited compatibility with the chromium matrix and can be used as a diffusion barrier on tungsten fibers at temperatures that do not exceed 1573 K.

A87-50898 An experimental study of the compaction of an Al-B fiber composite (Eksperimental'noe issledovanie protessa kompaktirovaniia voloknistogo kompozitsionnogo materiala Al-B). B. A. AREF'EV and I. V. MAKSIMCHUK, *Fizika i Khimiia Obrabotki Materialov* (ISSN 0015-3214), May-June 1987, pp. 100-104. 10 Refs.

The nature and the rate of fiber-matrix interaction in an Al-B fiber composite are investigated experimentally as a function of the compaction process variables. It is shown that the compaction of fiber composites includes two stages: the stage of active deformation and deformation in the creep mode. Generalized kinetic curves are proposed which provide a way to determine the contribution of each stage to the final strength of the bond between the fiber and the matrix.

A87-47532 Evaluation of the reliability of aluminum-matrix composites (Otsenka nadezhnosti kompozitsionnykh materialov s alluminiyevoi matritsei). I. N. SHKANOV, G. A. KRIVOV, V. N. SHLIANNIKOV, and V. V. OTDEL'NOV, *Problemy Prochnosti* (ISSN 0556-171X), June 1987, pp. 54-57. 6 Refs.

An evaluation is made of the strength and reliability characteristics of unidirectional aluminum/boron and aluminum/steel composites with fiber volume fractions of 15, 27, and 33 percent and 15, 25, and 40 percent, respectively. A new method for evaluating the reliability of composites is proposed which is based on determining the residual strength of a composite from fixed values of the fatigue life. By using this method, it is possible to determine the useful life of a structure from the known stress level or to select the permissible stress level on the basis of the known life.

A87-47529 Design of insert profiles for fiber composite structures (Proektirovanie profil'ov vkladnykh elementov dlia konstruktssii iz kompozitsionnykh voloknistykh materialov). I. U. P. ROMASHOV, V. I. ROMASHKO, and I. A. DAVYDOV, *Problemy Prochnosti* (ISSN 0556-171X), June 1987, pp. 20-23.

A method is proposed for designing the inserts of filament-wound composite structures. The method provides a way to determine the meridian of the insert profile in such a way as to ensure equal strength of the composite over the whole contact area. It is shown that the use of inserts with a variable curvature profile rather than constant-curvature inserts to ensure equal strength over the contact surface increases the strength of the composite structures of this kind by 10-15 percent. A filament-wound composite flywheel with an insert is examined as an example.

A87-47471 Plotting fatigue curves in the case of the high-cycle loading of reinforced plastics at constant strain amplitude (Postroenie krivyykh ustalosti pri zhestkom mnogotsiklovom nagruzhении armirovannykh plastikov). P. P. OLDYREV, *Mekhanika Kompozitsionnykh Materialov* (ISSN 0203-1272), May-June 1987, pp. 457-463. 19 Refs.

The methodological aspects of the testing of composites under conditions of constant cyclic-strain amplitude are discussed. Fracture criteria based on fatigue kinetics are proposed, and it is shown that, under constant cyclic-strain amplitude conditions, the fatigue life depends on the method used to maintain a given load. For glass-fiber and organic-fiber composites based on a thermoplastic matrix, the sigma-(log N) curves are shown to be equidistant during a symmetric cycle under both stress-controlled and strain-controlled cyclic loading along the stress axis.

A87-42137 Full-strength and minimum-weight conical and composite shells of revolution (Ravnoprechnyye i optimal'nye po masse konicheskie i sostavnye obolochki vrashcheniia). I. U. V. NEMIROVSKII and A. V. SHUL'GIN, *Aviatsionnaya Tekhnika* (ISSN 0579-2975), no. 1, 1987, pp. 58-63. 10 Refs.

The problem of the minimum-weight design of plastic sandwich shells is solved using the criterion of a constant energy dissipation rate. A unified procedure is developed for the optimum and full-strength design of conical and composite shells of revolution subjected to axisymmetric loading. It is shown that absolute-minimum-volume designs provide significant savings in materials in comparison with full-strength designs.

A87-43642 Strength and damage characteristics of ceramic-matrix carbon composites (Prochnost' i povrezhdaemost' uglerodnykh kompozitsionnykh materialov s keramicheskoi matritsei). E. A. ESKIN, G. P. KHRISTOV, A. S. PETROV, V. K. FEDCHUK, and A. V. IZOTOV, *Problemy Prochnosti* (ISSN 0556-171X), no. 5, May 1987, pp. 80-84. 11 Refs.

An experimental study is made of the effect of a high-temperature oxidizing medium on the load-bearing capacity of ceramic-matrix composites reinforced by carbon fabric with and without a heat-resistant coating. Changes in the load-bearing capacity, strength, and damage of the materials tested are related to the time of exposure to the high-temperature oxidizing medium. It is shown that oxidation starts with the carbon fibers and that there is a linear relationship between the thickness of the oxidized layer and the heating time.

A87-46098 A class of singular-perturbation boundary value problems in two-dimensional elasticity (Odn klass singuliarno vozmushchennykh kraevykh zadach v dvumernoi teorii uprugosti). I. U. A. BOGAN, *PMTF - Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki* (ISSN 0044-4626), Mar.-Apr. 1987, pp. 138-143. 8 Refs.

In the analysis of boundary value problems for an elastic medium reinforced by a single type of fiber, a model of an elastic medium with inextensible fiber is often used as the limiting case. Here, several theorems are proved on the convergence of such a class of singular-perturbation boundary value problems to the limiting problem in the corresponding Hilbert space. It is shown that, in some cases, the limiting system of equations is different from that obtained on the basis of the inextensibility hypothesis.

A87-44280 Determination of thermal boundary conditions from temperature measurement data (Opredelenie teplovyykh granichnykh uslovii po dannym temperaturnykh izmerenii). V. E. ABALTUSOV and I. K. ZHAROVA, *Akademiia Nauk SSSR, Sibirskoe Otdelenie, Izvestiia, Seriya Tekhnicheskie Nauki* (ISSN 0002-3434), April 1987, pp. 33-38. 14 Refs.

An approach to solving problems in heat and mass transfer is proposed whereby experimental data on heat transfer and thermochemical decomposition of composite materials in an air plasma flow are used, together with a solution to the inverse heat conduction problem, to determine the thermal boundary conditions at the surface of a material. The method is demonstrated by using it to calculate the surface temperature and heat flow from experimental data for glass/epoxy and carbon/graphite composites.

A87-41757 A study of matrix-fiber interaction in nickel- and chromium-based composite materials (Issledovanie vzaimodeistviia matritsy s voloknom v kompozitsionnykh materialakh na nikel'noi i khromovoi osnove). A. V. SHUL'GA and V. V. NIKISHANOV, *Fizika i Khimiia Obrabotki Materialov* (ISSN 0015-3214), Mar.-Apr. 1987, pp. 114-117. 5 Refs.

Matrix-fiber interaction in chromium-tungsten, nickel-tungsten, Nichrome-tungsten, and Nichrome-Mo(Cr) fiber composites is investigated experimentally in the temperature range 1200-1400 C. The structure of the interaction zone is examined metallographically. Of the composites studied, Cr-W is characterized by the least matrix-fiber interaction. It is shown that the addition of MgO leads to a decrease in the growth rate of the interaction zone in a chromium matrix.

A87-38872 The effect of delamination on the strength of unidirectional organic-fiber composites in tension (Vlianie rassloeniia na prochnost' odnonapravlennykh organoplastikov pri rastiazhenii). E. F. KHARCHENKO, S. L. BAZHENOV, V. D. PROTASOV, AL. AL. BERLIN, *Mekhanika Kompozitsionnykh Materialov* (ISSN 0203-1272), Mar.-Apr. 1987, pp. 345-348.

A study is made of the fracture behavior, under tensile loading, of a highly reinforced organic-fiber composite containing 95-97 percent (by volume) of profiled polyheteroarylene fibers and 3-5 percent of a polymer matrix. It is shown that the fracture of the composite starts with the growth of a longitudinal crack, which is followed by the disintegration of the composite into small loose fragments consisting of several elementary fibers. The strength of the composite increases with the delamination energy of the material.

A87-38869 New aspects of the fracture kinetics of polymeric and composite materials exposed to ultraviolet radiation (Novye aspekty kinetiki razrusheniia polimernykh i kompozitnykh materialov pri ul'trafioletovom obluchenii). V. A. BELYI, L. S. KORETSKAIA, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Mar.-Apr. 1987, pp. 262-269.

A new kinetic model of polymer and composite fracture under atmospheric conditions is proposed which is based on the newly discovered effect of the difference between the thermal deformations of a solid due to ultraviolet and infrared radiation. It is shown theoretically and experimentally that the life of composite materials depends on the following controllable matrix parameters: molecular structure, supramolecular organization, and defects. Transformations of supramolecular structures in polymers during atmospheric aging are considered to provide the principal means of controlling the life of polymeric and composite materials through the formation of a physically stable structure.

A87-36112 The effect of processing conditions on the structure formation and electrical conductivity of hot-pressed materials in the system silicon nitride-silicon carbide (Vliianie uslovii polucheniia na struktureobrazovanie i elektroprovodnost' gorlachepressovannykh materialov v sisteme nitrid-karbid kremniia). G. G. GNESIN, A. A. KASIANENKO, V. IA. PETROVSKII, L. A. SHILOVA, and E. I. GERVITS, *Poroshkovaia Metallurgii* (ISSN 0032-4795), Feb. 1987, pp. 51-54. 9 Refs.

The density, structure, and electrical resistance of hot-pressed Si₃N₄-SiC materials containing 5-30 pct SiC (by volume) are investigated experimentally as a function of the hot-pressing temperature in the range 1870-2010 K. It is found that the structure and electrical conductivity of the materials are determined to a large degree by the extent of Si₃N₄ carbidization and by the reduction of the SiO₂ surface film. Materials with low SiC contents are shown to be particularly sensitive to temperature. The extent of physicochemical transformations in the system correlates well with specific mass losses.

A87-35889 Thermal conductivity and diffusivity of an MR composite (Teplo- i temperaturoprovodnost' kompozitsionnogo materiala MR). M. M. ISMAILOV, E. A. BELSKAIA, and V. M. POLIAEV, *Teplofizika Vysokikh Temperatur* (ISSN 0040-3644), Vol. 25, Jan.-Feb. 1987, pp. 183-186. 8 Refs.

The paper reports the results of an experimental study of the thermal conductivity and diffusivity of an MR composite (a metal analog of rubber) produced by the cold pressing of stretched metal spiral. In particular, the temperature dependences of conductivity and diffusivity in air, vacuum, argon, and nitrogen have been determined for specimens made of 12Kh18N10T steel wire covering a porosity range of 0.55-0.81. For all the specimens tested, the temperature dependences of thermal diffusivity and conductivity increase monotonically both in vacuum and in gas atmospheres. Details of the experimental procedure are discussed.

A87-34195 Estimation of the energy storage capacity of rotating bodies from the integral characteristic of their stressed state (Otsenka energoemkosti vrashchaiushchikhsia tel po integral'noi kharakteristike ikh napriazhennogo sostoiianiia). G. G. PORTNOV, *Problemy Prochnosti* (ISSN 0556-171X), Feb. 1987, pp. 7-12. 10 Refs.

An approach to the design of rotating structures for maximum energy storage capacity is proposed which is based on an analysis of the relationship between the kinetic energy of a rotating body and the volume integral of the first invariant of its stressed state. Equally stressed structures are found to have the highest energy storage capacity; energy storage capacity estimates are obtained for composite structures and structures with a ballast. The results of the study have been used in the design of composite energy-storage flywheels.

A88-14749 Initial stage of the fracture of organic fiber composites (O nachal'noi stadii razrusheniia organoplastikov). V. I. IRZHAK, L. I. KUZUB, O. V. NIKITINA, B. A. ROZENBERG, N. S. ENIKOLOPIAN, *Akademiia Nauk SSSR, Doklady* (ISSN 0002-3264), Vol. 296, no. 1, 1987, pp. 147-150. 10 Refs.

The effect of the complex structure of organic fibers on the fracture mechanism of organic fiber composites is investigated experimentally using specimens of a model composite consisting of an epoxy matrix reinforced by crystalline aramid fibers of the Kevlar type. The results of the study suggest that the rupture of the interface in the surface layer of the fibers followed by fiber-matrix separation constitutes an important stage in the fracture of organic fiber composites under tensile loading.

A87-34191 The possibility of producing a highly disperse composite material in pulsed high-enthalpy flow (O vozmozhnosti polucheniia vysokodispersnogo kompozitsionnogo materiala v impul'snom vysokotent'piinom potoke). I. V. BLINKOV, A. G. BRODIAGIN, and A. V. IVANOV, *Fizika i Khimii Obrabotki Materialov* (ISSN 0015-3214), Jan.-Feb. 1987, pp. 111-115. 7 Refs.

The possibility of the formation of a disperse composite material, TiC-Mo, in the temperature range 1200-2800 K is demonstrated thermodynamically, and the effect of H/Cl and C/Ti ratios on the composition of the material is discussed. A study of the plasma-chemical production of a disperse composite in pulsed mode shows that the chemical composition of the product can be controlled by varying the energy and flow rate parameters and component feed conditions. The resulting TiC-Mo powders have a particle size of about 10 nm and are characterized by highly uniform distribution of Mo and TiC, which eliminates the need for prolonged component mixing.

A87-47465 Effect of thermal cycling on the internal friction of an aluminum/steel composite (Vliianie termotsiklirovaniia na vnutrennee trenie kompozitsionnogo materiala aliuminii-stal'). G. G. MAKSIMOVICH, A. V. FILIPOVSKII, P. M. ZUZIYAK, and A. V. MOZGOVOI, *Fiziko-Khimicheskaiia Mekhanika Materialov* (ISSN 0430-6252), Vol. 23, May-June 1987, pp. 77-79. 8 Refs.

The characteristics of the internal friction of a composite consisting of an AD1 aluminum alloy matrix unidirectionally reinforced by 100-micron-diameter fibers of 0Kh13N13M2 steel are investigated experimentally during thermal cycling in the temperature ranges 20-300 and 20-400 C. Thermal cycling in the range 20-300 C does not produce inelastic effects on the internal friction vs temperature curve but significantly affects internal friction characteristics at 280-300 C. Thermal cycling in the range 20-400 gives rise to inelastic effects at 230, 270, 300, and 360 C. The results are explained in terms of dislocation mechanisms.

A87-41772 A continuum model of composite fracture under biaxial compression (O kontinual'noi teorii razrusheniia kompozitnykh materialov pri dvukhosnom szhatii). A. N. GUZ', *Akademiia Nauk SSSR, Doklady* (ISSN 0002-3264), Vol. 293, no. 4, 1987, pp. 805-809. 7 Refs.

The fracture of composite materials under biaxial compression, with fracture resulting from a loss of stability in the material structure, is analyzed using a continuum approach. The analysis is carried out in general form for the brittle fracture of polymer-matrix composites and the ductile fracture of metal-matrix composites. In the continuum approximation, the composites are modeled by a homogeneous compressible body with normalized constants using the relationships of three-dimensional linearized stability theory for deformable bodies. Model predictions are compared with experimental results for a boron/epoxy composite.

A87-40320 Prospects in the production of fiber composites (Perspektivy proizvodstva voloknistykh kompozitsii). V. N. CHACHIN, A. S. MATUSEVICH, A. G. BAKAEV, and A. E. AZARENKO, *Kovove Materialy* (ISSN 0023-432X), Vol. 25, no. 2, 1987, pp. 181-185.

A process for producing composite shapes which combines casting and pressing is described with particular reference to the production of composites consisting of an aluminum or an aluminum alloy matrix reinforced by boron fibers. It is shown that the process makes it possible to take full advantage of the high strength characteristics of boron fibers. Thus, a composite with a volume fraction of boron fibers of 60-65 percent has a tensile strength of 1200-1300 MPa and a compressive strength of 2000 MPa, with an elastic modulus as high as 224 GPa for a density of 2600-2700 kg/cu m.

A88-11229 Estimation of thermal stresses and their effect on the properties of titanium-matrix fiber composites (Otsenka termicheskikh napriazhenii i ikh vliianie na svoistva voloknnistykh kompozitsionnykh materialov s titanovoi matritsei). A. S. LAVRENKO, V. E. OL'SHANETSKII, and G. I. DUDNIK, *Problemy Prochnosti* (ISSN 0556-171X), Aug. 1987, pp. 60-64. 10 Refs.

Axial thermal stresses in the components of a titanium-matrix composite reinforced by molybdenum fibers are investigated as a function of temperature, with allowance made for the dependence of the yield strength of the matrix alloy on the composite thermal loading rate. It is found that internal stresses have a direct effect on the short-term strength of the composite, whose value is always less than the rule-of-mixtures value at test temperatures below 600 C. It is thought, however, that the presence of thermal stresses is not the factor responsible for composite fracture under cyclic loading.