

Russian and Japanese Aerospace Literature

Throughout 1992 the *AIAA Journal* will carry selected abstracts on leading research topics from Russian aerospace literature and, as space permits, from similar Japanese literature. The topics will be chosen and the abstracts reviewed for pertinency by *AIAA Journal* editors. This month features Composite Materials from Russia and Neural Networks from Japan.

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-4373. 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 most of the original documents are in the original language. Direct questions concerning this abstract section of the *AIAA Journal* to Norma Brennan, Director, Journals.

Russian Aerospace Literature This month: *Composite Materials*

A92-18338 Theory of the small elastoplastic deformations of randomly reinforced composite materials (K teorii malykh uprugoplasticheskikh deformatsii khaoticheskii armirovannykh kompozitsionnykh materialov). I. S. MAKAROVA and L. A. SARAEV, *PMTF—Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki* (ISSN 0044-4626), Sept.–Oct. 1991, pp. 120–124. 8 Refs.

The elastoplastic properties of a composite material containing nonoriented ellipsoidal inclusions are investigated in the context of the mechanics of randomly inhomogeneous media. Expressions for calculating the elastoplastic properties of randomly reinforced composites are obtained and applied to a composite made of a sintered aluminum powder (14 percent Al₂O₃). The results are compared with experimental data.

A92-10870 Prevention of edge delamination in composite laminates (Predotvrashchenie kromochhnogo rasslaivaniia sloistykh plastikov). I. U. PEROV, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), May–June 1991, pp. 468–473. 15 Refs.

Ways of preventing edge delamination in polymer composites are examined, with particular attention given to minimizing or eliminating interlayer stress peaks in the edge effect region by varying the layup structure and layer thickness ratios or by using mechanical modifications of the finished product. The effectiveness of using an isotropic adhesive layer in the plane of maximum predicted stresses is evaluated theoretically and experimentally. This method is shown to completely prevent edge delamination and significantly increase the laminate strength with only a slight reduction in stiffness.

A91-55399 Effect of the composition of the sprayed material on the service characteristics of solid lubricant coatings (Vlianie sostava i struktury napyliamogo materiala na ekspluatatsionnye kharakteristiki tverdostmazochnykh pokrytii). I. U. G. LEKAREV, V. V. MAKSIMOV, V. A. BARVINOK, and A. A. CHEKMAREV, *Heat-resistant inorganic coatings* (A91-55394 24–26). Leningrad, Izdatel'stvo Nauka, 1990, pp. 159–162.

The principal performance characteristics of metal-encapsulated solid lubricant coatings intended for use in gas turbine seals were investigated as a function of the plasma-sprayed composite material. In the specimens studied, boron nitride and calcium fluoride were used as the solid lubricant component, while aluminum bronze, nickel, and Kh20N80 alloy were used as the metallic component. It is shown that the reinforcement of the solid lubricant core and the presence of a surface metal layer make it possible to reduce BN losses during spraying and to increase its content in the coating. The principal physicomechanical properties of the Kh20N80 coating are presented.

A91-55392 A study of the properties of thermally sprayed coatings of composite nickel-titanium carbide and chromium carbide powders (Issledovanie svoistv gazotermicheskikh pokrytii iz kompozitsionnykh poroshkov nikel'-karbid titana i khroma). I. N. GORBATOV, V. M. SHKIRO, A. E. TERENT'EV, L. K. SHVEDOVA, I. S. MARTSENIUK, and S. V. KARPENKO, *Fizika i Khimiia Obrabotki Materialov* (ISSN 0015-3214), July–Aug. 1991, pp. 102–106. 8 Refs.

The objective of the study was to investigate the heat resistance (500–1000 C) and friction characteristics of plasma-sprayed coatings based on composite powders produced by the nickel plating of titanium or chromium carbides. The highest heat resistance is obtained in the case of composite coatings with a high chromium content. The coatings exhibit good friction characteristics and can be used as antifriction materials.

A91-47588 Solution of nonstationary thermoelastic deformation problems for laminated composite structures by the finite element method (Reshenie nestatsionarnykh zadach termouprugogo deformirovaniia sloistykh kompozitnykh konstrukttsii metodom konechnykh elementov). V. S. SIPETOV, O. N. DEMCHUK, and R. A. STARODUB, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Mar.–Apr. 1991, pp. 215–222. 13 Refs.

A Galerkin-type finite element calculation scheme is used to solve the noncoupled thermoelasticity problem for thermally sensitive laminated composite structures. The three-dimensional thermal conductivity problem is reduced to a two-dimensional problem by using the hypothesis of piecewise linear or nonlinear temperature distribution over the structure thickness. The problem of determining the thermal stressed state is solved in increments.

A91-47587 Solution of the plane elasticity problem for a multilayer orthotropic composite (K resheniiu ploskoi zadachi teorii uprugosti dlia mnogosloinogo ortotropnogo kompozita). V. K. PRISIAZHNIUK and I. B. ZAIVILEV, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Mar.–Apr. 1991, pp. 206–214. 15 Refs.

The plane elasticity problem for a multilayer orthotropic composite is solved in the case of boundary conditions of the Navier kind. Various combinations of the physical constant of the composite, leading to three types of solutions to the characteristic equation, are analyzed. By introducing hypotheses about the displacement vector, the plane elasticity problem is reduced to a one-dimensional problem which, however, allows for all the stress and strain tensor components. The validity of the approach is demonstrated for the case of an inhomogeneous high beam loaded by a normal sinusoidal force.

A92-10867 Effect of the interaction of parallel cracks in composites on the distribution of the distance between cracks (Vliianie vzaimod-eistviia parallel'nykh treshchin v kompozitakh na raspredelenie rassstoianiiia mezhdum nimi). S. S. ABRAMCHUK and V. D. PROTASOV, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), May-June 1991, pp. 430-439. 13 Refs.

A relationship between the probability density of the distance between the nearest parallel cracks and their mean concentration is obtained theoretically assuming a constant noneffective length of the stressed state perturbation zone near the crack edge. For low concentration values, the probability density is shown to tend to a truncated exponential distribution.

A92-10843 Exact solution of a plane problem for a composite plane with a crack across the interface (Tochnoe reshenie ploskoi zadachi dlia sostavnoi ploskosti s razrezom, pereseкаиushchim liniu razdela sred). I. U. A. ANTIPOV and N. G. MOISEEV, *Prikladnaia Matematika i Mekhanika* (ISSN 0032-8235), Vol. 55, July-Aug. 1991, pp. 662-671. 8 Refs.

An exact closed-form solution is presented for the problem of stress concentration in a composite elastic plane near a rectilinear crack orthogonal to the interface. The solution is based on the factorization of a matrix coefficient of a special kind in the Riemann problem to which the elasticity problem is reduced. The solution is obtained in quadratures in a form convenient for numerical implementation. Formulas for calculating stress intensity factors and a numerical example are presented.

A91-47593 Stability of panels of composite materials reinforced by open-section rods (Ustoichivost' paneli iz kompozitnykh materialov, podkreplennykh sterzhniami otkrytogo profilii). A. A. DUDCHENKO and A. N. ELPAT'EVSKII, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Mar.-Apr. 1991, pp. 315-319. 4 Refs.

The stability problem for composite panels reinforced by open-section rods is analyzed using a Vlasov-type variational approach. The solution leads to an analysis of two principal forms of panel behavior under conditions of local buckling under compression. The energy form of the solution makes it possible to obtain a simple formula for determining the critical load and to analyze its effect on individual structural parameters.

A91-47591 Fracture of orthotropic elastic-plastic composites with a crack under biaxial loading (Razrushenie ortotropnykh uprugoplasticheskikh kompozitov s treshchinoi pri dvukhsnom nagruzhении). A. A. KAMINSKII, O. S. DEGTIAREVA, and G. V. GALATENKO, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Mar.-Apr. 1991, pp. 284-291. 7 Refs.

The behavior of a crack in an orthotropic elastic-plastic material under biaxial loading is investigated with allowance for the type of the yield surface of the material using a generalized delta- c fracture model. Materials satisfying the Mises-Hill and Goldenblat-Kopnov plasticity conditions are examined as an example.

A91-45000 Methods and equipment for the quality control of composite materials (Metody i sredstva kontroliia kachestva kompozitnykh materialov). I. G. MATIS, *Defektoskopiia* (ISSN 0130-3082), No. 4, 1991, pp. 77-87. Refs.

The applied research carried out at the Polymer Mechanics Institute of the Latvian Academy of Sciences in the field of the nondestructive testing of composite materials is reviewed. Brief descriptions of instruments for the monitoring of the ultrasonic, thermal, electrical, and mechanical characteristics of composites are presented, and their applications are illustrated by examples. Particular attention is given to applied research related to acoustic and dielectric spectrometry.

A91-43214 Plane problem of the fracture of structural materials under compression along two parallel cracks (Ploskaia zadacha razrusheniia konstruktsionnykh materialov pri szhatii vdol' dvukh parallel'nykh treshchin). A. N. GUZ', V. M. NAZARENKO, and I. P. STARODUBTSEV, *Prikladnaia Mekhanika* (ISSN 0032-8243), Vol. 27, April 1991, pp. 29-38. 24 Refs.

The fracture behavior of composite and elastic-plastic materials under compression along two internal macrocracks is examined using a previously proposed fracture criterion. The composite is treated in the continuum approximation as an anisotropic medium with reduced macrocharacteristics. Numerical results for specific materials, including boron/epoxy and carbon/carbon composites are compared with results obtained on the basis of approximate approaches based on applied beam, plate, and shell theories.

A91-43181 Effect of anisotropy in shells of revolution under nonaxisymmetric loading (Ob effekte anizotropii v obolochkakh vrashcheniia pri neosesimmetrichnom nagruzhении). E. I. GRIGOLIUK and P. I. A. NOSATENKO, *Akademiia Nauk SSSR, Doklady* (ISSN 0002-3264), Vol. 316, No. 6, 1991, pp. 1354-1357. 8 Refs.

The characteristics of the stress-strain state of cross-reinforced layered anisotropic composite shells of revolution under nonaxisymmetric loading are investigated analytically on the basis of the numerical solution of the three-dimensional elasticity problem. It is shown that the effect of anisotropy on the stress-strain state of cross-reinforced composite shells of revolution remains practically unchanged as the load varies along the circumferential coordinate. The effect is minimal in the case of axisymmetric deformation.

A91-41317 Local instability of layered compressible composites—Three-dimensional problem (Lokal'naia neustoichivost' sloistykh szhimaemykh kompozitov—Prostranstvennaia zadacha). I. A. GUZ', *Akademiia Nauk SSSR, Izvestiia, Mekhanika Tverdogo Tela* (ISSN 0572-3299), Mar.-Apr. 1991, pp. 49-55. 11 Refs.

The local instability of layered compressible composites is analyzed in three dimensions for buckling modes represented in the form of Fourier integrals. A solution is presented in unified form in the context of the theory of finite subcritical deformations and two versions of the theory of small subcritical deformations for elastic and elastoplastic compressible layers and half-spaces homogeneous along the Ox_1 and Ox_2 axes. The discussion is illustrated by numerical results obtained for a layered boron/aluminum composite.

A91-41167 Analysis of the load-bearing capacity of fiber composite structures (Analiz nesushchei sposobnosti konstruktssii iz voloknistykh kompozitov). V. A. ZARUBIN, *Aviatsionnaia Tekhnika* (ISSN 0579-2975), No. 1, 1991, pp. 76-80. 8 Refs.

The use of a finite element code for optimizing the design of fiber composite structures with respect to their load-bearing capacity is examined with particular reference to wing-type structures. Efficient reinforcement patterns are determined by using mathematical programming techniques. An algorithm is developed for calculating the load-bearing capacity of wings with fiber composite skins with allowance for various nonlinear effects.

A91-35700 Digital filtering during automatic crack detection and measurement in products of composite materials (Tsifrovaia fil'tratsiia pri avtomaticheskoi defektometrii treshchin v izdeliakh iz kompozitsionnykh materialov). V. S. KHANDETSKII and A. T. GRECHKA, *Priboroostroenie* (ISSN 0021-3454), Vol. 33, Dec. 1990, pp. 41-46. 8 Refs.

A real-time filtering process is described which allows for the modulation characteristics of defects, composite surface relief, and the rate of change of electrical conductivity along the scanning paths. The filter has been implemented on a specialized microprocessor built into the instrument circuit. The minimal detectable crack depth is 0.5 mm, the accuracy of depth measurements is 8-12 percent or better. A diagram of the filtering algorithm is presented.

A91-33825 Efficient reinforcement of shells for compression (O ratsional'nom armirovanii rabotaiushchikh na szhatie obolochek). D. V. BABICH, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Jan.-Feb. 1991, pp. 157-160. 5 Refs.

The effect of the composite structure on the stability of layered and macrohomogeneous (in the thickness direction) shells under axial and radial compression is investigated numerically. Based on the results obtained, a procedure is presented for optimizing the layup angles and reinforcement ratios for maximum stability. Three possible ways of increasing the critical load are examined.

A91-33824 Stability, postbuckling behavior, and optimization of composite shells (Ustoichivost', zakriticheskoe povedenie i optimizatsiia obolochek iz kompozitnykh materialov). N. P. SEMENIUK and N. B. ZHUKOVA, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Jan.-Feb. 1991, pp. 132-137. 12 Refs.

A method is proposed for calculating the stability and initial postbuckling behavior of smooth layered and reinforced composite cylindrical shells. The method is based on equations of the linear theory of Timoshenko shells, with allowance made for transverse shear in the reinforcing ribs and discrete arrangement of the ribs. The principal relations of the theory of initial postbuckling behavior are derived for the shells studied using the principle of possible displacements. It is shown that the application of the method proposed here to structure analysis provides a new estimate of the optimality of structures with initial imperfections.

A91-28123 Third-order effective elastic moduli of composites (Effektivnye moduli uprugosti kompozitov tret'ego poriadka). V. A. BURIACHENKO and A. M. LIPANOV, *PMTF—Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki* (ISSN 0044-4626), Nov.-Dec. 1990, pp. 118-123. 7 Refs.

A method is proposed for calculating the second- and third-order macroscopic elastic moduli of composites. The method is based on the solution of the problem of binary interactions between inclusions in an effective field, assuming deformation homogeneity within each inclusion. The analysis is based on the assumption of the homogeneity of the second components of deformation fields in the components.

A91-26449 Stressed state in a layered composite with partial warpage in the structure (O napriazhennom sostoianii v sloistom kompozitnom materiale s chastichnymi iskrivleniiami v strukture). S. D. AKBAROV and S. A. ALIEV, *Prikladnaia Mekhanika* (ISSN 0032-8243), Vol. 26, Dec. 1990, pp. 16-21. 13 Refs.

A method for solving the stress-strain problem for composite materials with partial warpage in the structure is developed on the basis of a piecewise homogeneous body model using exact linear elasticity equations. The number of the warped layers is assumed to be finite. Numerical calculations are presented for several specific problems. A comparison of the results obtained with results obtained by other methods demonstrates the efficiency of the approach.

A91-26450 Dynamics and stability of layered composite structures with interfacial delaminations (K probleme dinamiki i ustoiichivosti sloistnykh kompozitsionnykh struktur s mezhfaznymi rassloeniami). B. L. PELEKH and O. S. MACHUGA, *Prikladnaia Mekhanika* (ISSN 0032-8243), Vol. 26, Dec. 1990, pp. 28-32. 11 Refs.

Composite structures with delaminations are treated as piecewise homogeneous bodies with interfacial defects of various kinds. Phase conjugation conditions are formulated for ideal contact regions, and hypotheses are proposed concerning the interaction between delamination surfaces. For layered composite structures, a method for obtaining dynamic equations and equations of neutral equilibrium is proposed. A numerical method based on the Bubnov procedure is proposed for solving problems of the natural vibrations and critical forces of layered composite shells with interfacial delaminations. The natural vibrations and stability of two-layer cylindrical shells with longitudinal and annular delaminations are examined as an example.

A91-25274 Generalization of the integral Fourier transform in the boundary value problems of composite mechanics (Obobshchenie integral'nogo preobrazovaniia Fur'e v kraevykh zadachakh mekhaniki kompozitov). V. Z. PARTON, B. A. KUDRIAVTSEV, and A. L. KALAMKAROV, *Akademiia Nauk SSSR, Doklady* (ISSN 0002-3264), Vol. 315, No. 1, 1990, pp. 53-56.

An attempt is made to develop a new method for solving problems in the mechanics of strongly inhomogeneous composite materials that are characterized by rapidly oscillating coefficients. A new type of integral transform is proposed which represents a generalization of the integral Fourier transform. The use of the formalism of new generalized integral transforms makes it possible to obtain an exact solution for some boundary problems in stationary and nonstationary elasticity and heat conductivity for regular layered composites.

A91-23816 Microwave heat testing of carbon composite components (SVCh teplovoi kontrol' kachestva izdelii iz ugleplastika). I. U. P. PLOKHOV and B. G. TSILIN, *Defektoskopiia* (ISSN 0130-3082), No. 12, 1990, pp. 66-75.

The microwave heating of cylindrical carbon composite sections incorporated into a coaxial waveguide was investigated theoretically and experimentally in an attempt to develop an active thermal fault-detection method. It is demonstrated that the active thermal inspection method using pulsed microwave heating is capable of detecting defects in sections of complex shape and determining their depth. The general design and operation of the pulsed microwave heater are described.

A91-18868 Composite materials produced by vapor phase deposition in vacuum (Kompozitsionnye materialy, poluchaemye osazhdeniem iz parovoi fazy v vakuumie). B. A. MOVCHAN, *Fizika i Khimiia Obrabotki Materialov* (ISSN 0015-3214), Sept.-Oct. 1990, pp. 108-117. 25 Refs.

The advantages of vacuum evaporation as a method of producing composite coatings, such as those used for gas turbine blades, are reviewed. In particular, it is shown that electron-beam evaporation of metals and nonmetals in vacuum and subsequent condensation of the vapor phase make it possible to vary the structure and properties of bulk condensates over a wide range. The structure and mechanical properties of two classes of vacuum evaporated composites, dispersion-strengthened (e.g., Ti-TiC, Ni-TiC, Si-SiC, and Co-WC) and microlayer (e.g., Cu/Fe, Cu/Cr, and Cu/Mn), are discussed. The commercial electron-beam equipment used for the production of these materials is also briefly reviewed.

A91-17172 Composite plates reinforced by high-modulus fibers (Kompozitsionnye plastiny, armirovannye vysokomodul'nymi voloknami). M. V. REZTSOV, *Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki* (ISSN 0044-4669), Vol. 30, Sept. 1990, pp. 1394-1404. 5 Refs.

The paper is concerned with the three-dimensional linear elasticity problem for a thin rigidly reinforced periodic layer. Assuming the physical symmetry of the layer relative to the middle surface, a full asymptotic expansion is constructed, and an estimate is made of the proximity of an exact solution and a truncated sum of the asymptotic series. A splitting principle is formulated for the main term of the mean operator. In the case of isotropic reinforcement fibers, explicit formulas are obtained for the effective moduli of the composition layer. The type of the averaged equation is investigated as a function of the reinforcement pattern.

A90-50832 A fracture criterion for multilayer composite plates and shells (Kriterii razrusheniia dlia mnogosloinykh kompozitnykh plastin i obolochek). I. G. TEREGULOV and E. S. SIBGATULLIN, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Jan.-Feb. 1990, pp. 74-79. 7 Refs.

Parametric equations of the limiting fracture surface are obtained in generalized force space for composite structures formed by the superposition of anisotropic layers. In the general case, the layers differ in thickness, strength characteristics, and orientation. Calculation results are presented to demonstrate the general nature and the wide possibilities of the relationships obtained here. A nonparametric equations of the limiting fracture surface is obtained in stress space for a layered composite with a symmetrical layup scheme. The results based on this equation are found to coincide with the results obtained from the parametric equations of the limiting fracture surface.

A91-21878 Characteristics of the effective moduli of composite plates (O svoistvakh effektivnykh modulei kompozitsionnykh plastin). M. V. REZTSOV, *Zhurnal Vychislitel'noi Matematiki i Matematicheskoi Fiziki* (ISSN 0044-4669), Vol. 30, Nov. 1990, pp. 1741-1743.

The effective moduli of composite plates are investigated analytically with reference to earlier studies on the averaging of composite plates. In particular, data are obtained which make it possible to generalize the results of the averaging studies to a composite layer whose structure is limited by the requirement of physical symmetry relative to the middle plane.

A91-15454 Fracture of a unidirectional ribbon-reinforced composite with an elastoplastic matrix under compression (Razrushenie odnonapravlenogo lentochnogo kompozita s uprugoplasticheskoi matritsei pri szhatii). A. N. GUZ' and DZH. A. MUSAIEV, *Prikladnaia Mekhanika* (ISSN 0032-8243), Vol. 26, May 1990, pp. 3-8. 19 Refs.

The stability of unidirectional ribbon-reinforced composites with an elastoplastic matrix is investigated analytically for low filler concentrations using a piecewise homogeneous medium model in the context of a three-dimensional linearized stability theory for deformable bodies at low subcritical deformations. The loss of stability of the structure is used as the fracture criterion. The strength limits of ribbon-reinforced composites are determined under compression along the reinforcement.

A91-15393 Automatic ultrasonic inspection of composites using rolling transducers (Avtomaticheskii ul'trazvukovoi kontrol' kompozitov katiashchimisia preobrazovateliami). V. G. IVANOV and L. I. SKOROBOGAT, *Defektoskopiia* (ISSN 0130-3082), No. 5, 1990, pp. 30-37. Refs.

A random scanning procedure using rolling transducers as part of an automatic ultrasonic inspection system is presented. Three-layer composite specimens are tested using a FORTRAN-4-PLUS program and it is concluded that the random scanning produces a three-fold enhancement of the sensitivity of the automatic control; the contrast of the ultrasonic image is improved and the acoustic impedance of the defects differs from the impedance of the material; the defects can be located using digital processing; the saving of machine time is considerable.

A90-50839 The accuracy of effective characteristics in composite mechanics (O tochnosti effektivnykh kharakteristik v mekhanike kompozitov). B. E. POBEDRIA, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), May-June 1990, pp. 408-413. 14 Refs.

The mathematical aspects of composite mechanics are briefly reviewed, and accurate effective characteristics of composite mechanics are defined. Methods of determining the effective characteristics are discussed with particular reference to elastic and linear viscoelastic inhomogeneous media. Formulas are obtained which can be used for determining stresses and strains in composites and for establishing fracture criteria.

A90-50838 A study of the characteristics of the integration of disperse polysulfone and reinforcing fibers in composite materials (Issledovanie zakonomernostei sovmeshcheniia dispersnogo polisul'fona s armiruiushchimi voloknami pri poluchenii kompozitnykh materialov). L. V. ZABORSKAIA, O. R. IURKEVICH, V. A. DOVGIALO, E. V. PISANOVA, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), May-June 1990, pp. 403-407. 10 Refs.

The characteristics of a prepreg production process whereby a disperse thermoplastic matrix is combined with a fiber reinforcement are examined with particular reference to polydisperse polysulfone and reinforcements in the form of carbon, glass, and organic fibers and fabrics. The wetting angle of the fibers is determined as a function of the initial size of the polymer matrix particles, and an anomaly in the wetting of a woven reinforcement is identified. It is shown that the interlayer shear strength of the composites depends to a large degree on the initial particle size of the disperse matrix material.

A90-48272 Stability of composite panels under compression and shear (Ustoiichivost' kompozitnykh panelei pri szhatii i sdvige). N. S. AZIKOV, V. V. VASIL'EV, and A. D. PATEREKAS, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Mar.-Apr. 1990, pp. 351-353.

A numerical solution is proposed for the shear stability problem for a hinged orthotropic rectangular plate. A table of stability coefficients is presented for a typical range of the geometrical and stiffness parameters of composite panels. The traditional parabolic relations between the critical values of normal and tangent stresses is shown to be valid for simultaneous compression and shear.

A90-48266 Experimental study of the strength and stability of carbon composite shells (Eksperimental'noe issledovanie prochnosti i ustoiichivosti obolochek iz ugleplastika). V. T. SHCHERBAKOV and A. G. POPOV, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Mar.-Apr. 1990, pp. 256-262. 13 Refs.

Experimental data are presented on the strength and stability of thin-walled shells fabricated by the winding of a carbon prepreg tape. The experimental results are compared with calculations, and the extent of the utilization of the strength characteristics of the composite in the plane-stress state and the effect of initial stresses on the critical stability stresses are estimated. The dependence of the critical stresses on the R/h parameter and the effect of the fabrication process on the mechanical properties of the shell material are discussed.

A90-50831 Automation of strength analysis and fracture of composite structures (Avtomatizatsiia raschetov na prochnost' i razrusenie konstruktsii iz kompozitnykh materialov). R. B. RIKARDS, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Jan.-Feb. 1990, pp. 69-73. 6 Refs.

The general structure of a set of finite-element software for solving problems in the statics, dynamics, and stability of composite structures is examined. As an example, a solution is presented for the problem of the nonstationary deformation of a shallow cylindrical shell of a carbon composite under pulsed loading. The efficiency of the general-purpose software described here is demonstrated.

A90-48268 Some applied problems in the mechanics of dimensionally stable composite structures (Nekotorye prikladnye zadachi mekhaniki razmernostabil'nykh konstruktsii iz kompozitov). V. V. VOROBIEI and N. I. VOITKOV, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Mar.-Apr. 1990, pp. 292-298. 5 Refs.

The dimensional stability of sandwich-type composite reflectors is examined with reference to the results of experimental and theoretical studies. An alternative transformable reflector structure is proposed which consists of dimensionally stable plates of reinforced composite. The optimum design problem is formulated, with the optimal computational model selected using a finite element code.

A90-48203 Characteristics of damage accumulation during the loading of brittle composite materials (Osobennosti nakopleniia povrezhdenii pri nagruzhении khrupkikh kompozitsionnykh materialov). A. M. SHIRIAEV and A. F. SHUROV, *Pis'ma v Zhurnal Tekhnicheskoi Fiziki* (ISSN 0320-0116), Vol. 16, Feb. 12, 1990, pp. 25-28.

Results of an acoustic emission study of the fracture behavior of various brittle composites are reported with emphasis on the newly discovered characteristics of damage accumulation under load. The experimental study was carried out on metal ceramics, porous glasses, glassceramics, and carbon composites. Two distinct types of damage accumulation curves are identified, depending on the initial porosity of the material, as determined by the conditions of hotpressing and annealing. It is also shown that the damage accumulation behavior of the composites tested is characterized by the Kaiser effect.

A90-46515 An approach to the determination of the linear fracture toughness characteristics with respect to normal tearing cracks in composite materials (Pro odin pidkhd do viznachennia liniinikh kharakteristik trishchinostiosti normal'nogo vidrivu v kompozitsi-inikh materialakh). M. V. DELIAVS'KII, L. I. ONISHKO, and L. T. BEREZHNIITS'KII, *Fiziko-Khimicheskaiia Mekhanika Materialov* (ISSN 0430-6252), Vol. 26, May-June 1990, pp. 59-65. 7 Refs.

A method is proposed for determining the structural fracture toughness characteristics of orthotropic composite materials using centrally notched rectangular test specimens. Details of the test procedure are reviewed, with particular attention given to the determination of the stressed state of the notched specimen and structural element size, selection of test specimens, determination of the fracture stress, and statistical processing of the experimental data.

A90-43016 Fluctuations of stresses in elastic composites (Fluktuatsii napriazhenii v uprugikh kompozitakh). V. Z. PARTON and V. A. BURIACHENKO, *Akademiiia Nauk SSSR, Doklady* (ISSN 0002-3264), Vol. 310, No. 5, 1990, pp. 1075-1078. 10 Refs.

The method of Bobeth and Diener (1986) is extended to obtain accurate estimates of all the tensor components of the second moment of the stress and strain field averaged over the component volume for elastic composites with ellipsoidal inclusions. Attention is given to the general case of the anisotropy of the mechanical properties of the components and their geometrical structure. Under the assumption of uniform random stress field in the vicinity of each ellipsoidal inclusion, a method based on perturbation theory shows that the second moment of the stress fields is constant within the inclusion.

A90-45115 Composite materials in large-scale optics (Kompozitsionnye materialy v krupnogabaritnoi optike). V. V. APOLLONOV, G. I. BABAIANTS, M. V. GARTMAN, V. M. GOLOMAZOV, I. D. LOKTIONOV et al., *Pis'ma v Zhurnal Tekhnicheskoi Fiziki* (ISSN 0320-0116), Vol. 16, Jan. 26, 1990, pp. 83-86. 5 Refs.

Recent developments in the use of composite materials for lightweight large-scale optics are reviewed. In particular, attention is given to the construction of large-scale optical elements made of composite materials based on the carbon-silicon-silicon carbide composition with an efficient thermal stabilization and good optical characteristics. The advantages of using honeycomb structures are noted in particular.

A90-42910 Behavior of a two-component medium under impulsive loading (O povedenii dvukhkomponentnoi sredy pri impul'snom nagruzhении). V. S. ZARUBIN and G. N. KUVYRKIN, *Prikladnaia Mekhanika* (ISSN 0032-8243), Vol. 26, Jan. 1990, pp. 91-98. 15 Refs.

The paper is concerned with materials representing a mixture of two components with different thermophysical and mechanical properties. Based on the thermodynamics of irreversible processes, a closed system of governing equations is obtained, with allowance made for changes in the internal parameters of each component. The propagation characteristics of waves of different types are examined.

A90-36094 The boundary layer method in the fracture mechanics of periodic composites (Metod pogranichnogo sloia v mekhanike razruseniia kompozitov periodicheskoi struktury). A. L. KALAMKAROV, B. A. KUDRIAVTSEV, and V. Z. PARTON, *Prikladnaia Matematika i Mekhanika* (ISSN 0032-8235), Vol. 54, Mar.-Apr. 1990, pp. 322-328.

The problem of a rectilinear crack in a composite with a bi-periodic structure is analyzed for the case where the crack size is significantly larger than the periodicity cell size. For the analysis of the stress field in the vicinity of a microcrack, a boundary layer method is proposed which is based on the asymptotic averaging of periodic structures with allowance for additional solutions of the boundary layer type. These solutions make it possible to allow for the edge effect in the vicinity of the crack boundary.

A90-30393 A study of local fields in the vicinity of a macrocrack in a composite with a periodic structure (K issledovaniu lokal'nykh polei v okrestnosti makrotreshchiny v kompozitsionnom materiale periodicheskoi struktury). V. Z. PARTON, A. L. KALAMKAROV, and V. G. BORISKOVS'KII, *Fiziko-Khimicheskaiia Mekhanika Materialov* (ISSN 0430-6252), Vol. 26, Jan.-Feb. 1990, pp. 3-9. 10 Refs.

A new numerical-analytical approach is proposed for studying the local structure of the stress-strain state near a macrocrack in a strongly inhomogeneous composite with a periodic structure. The approach is based on the asymptotic averaging of periodic structures with allowance for additional boundary layer solutions that model local effects arising near the crack. The problem of a tearing macrocrack in a two-phase layered composite is analyzed as an example. Local stressfield distributions near the crack tip are obtained, and an analysis is made of the dependence of the stress intensity factors on the composite component characteristics.

A90-27308 Deformation of composite beams under transverse impact (Deformirovanie kompozitnykh balok pri poperechnom udare). S. I. SNISARENKO, *Problemy Prochnosti* (ISSN 0556-171X), Feb. 1990, pp. 114-119. Refs.

The contact force for carbon composite beams loaded in transverse impact is determined experimentally and analytically. The problem is stated and solved using the finite element method and the Timoshenko shear theory. The principal finite element equation is integrated by the Runge-Kutta method. An analysis of the experimental and analytical results indicates that the form, magnitude, and duration of the contact force depend on the elastic and strength characteristics of the contact surface and are largely determined by the natural frequency spectrum. Maximum nonstationary flexural and shear deformations are observed in beams whose first eigenfrequency half-periods are comparable with the impact duration.

Japanese Aerospace Literature This month: Neural Networks

A91-47069 Neural processing-type displacement sensor employing multimode waveguide. SHIGEKI AISAWA, KAZUHIRO NOGUCHI, and TAKAO MATSUMOTO, *IEEE Photonics Technology Letters* (ISSN 1041-1135), Vol. 3, April 1991, pp. 394-396. 8 Refs.

A novel neural processing-type displacement sensor, consisting of a multimode waveguide and a neural network, is demonstrated. This sensor detects displacement using changes in the interference output image of the waveguide. The interference image is directly processed by a three-layer perceptron neural network. Environmental change, such as the intensity fluctuation, and change of the temperature can be followed by training the neural network. Experimental results show that the sensor has a resolution of 1 micron.

A91-43684 Lateral inhibitory action in an optical neural network using an internal-light-coupled optical device array. WATARU KAWAKAMI, KEN-ICHI KITAYAMA, YOSHINORI NAKANO, MASAHIRO IKEDA, *Optics Letters* (ISSN 0146-9592), Vol. 16, July 1, 1991, pp. 1028-1030. 7 Refs.

A novel configuration of an optical lateral inhibitory neural network using a two-dimensional internal-light-coupled optical device (ILCOD) array is proposed. It is experimentally certified with a test ILCOD structured with seven units in a two-dimensional hexagonal arrangement that the optical coupling between the units causes turn-off of the light emission of the unit in a specific position, which results in lateral inhibitory action of a neural network.