A89-35486 Relationship between the structure, fracture energy, and strength of fiber composites (Sviaz' struktury, energoemkosti razrusheniia i prochnosti voloknistogo kompozita). V. S. KRIVOBODROV and A. M. LEKSOVSKII, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Jan.-Feb. 1989, pp. 29-35. 13 Refs.

The effect of structural characteristics on the strength and fracture mode of fiber composites is investigated analytically using a criterion relating the formation of a main crack to the fracture energy content. Expressions are obtained which relate the critical stresses to the interface shear strength and fiber volume fraction. It is shown that the model proposed here can be generalized to the case of multicomponent reinforcement.

A89-30038 Development of a fracture theory for composites in triaxial and biaxial compression (O postroenii teorii razrusheniia kompozitnykh materialov pri trekhosnom i dvukhosnom szhatii). A. N. GUZ', *Prikladnaia Mekhanika* (ISSN 0032-8243), Vol. 25, Jan. 1989, pp. 36-43. 11 Refs.

A fracture theory for composites loaded in triaxial and biaxial compression is developed for the case where fracture results from stability loss in the composite structure. The properties of the material are described using the continuum approximation and the principal equations of three-dimensional linearized stability theory for deformable bodies. The analysis is carried out with particular reference to the brittle and ductile fracture of composite materials with polymer and metallic matrices.

A89-27265 A study of damage accumulation in a fiber composite using a numerical experiment (Issledovanie protsessa nakopleniia povrezhdenii v voloknistom kompozite metodom chislennogo eksperimenta). I. N. ZHDANOVA and D. N. KARPINSKII, *Zhurnal Tekhnicheskoi Fiziki* (ISSN 0044-4642), Vol. 58, Nov. 1988, pp. 2266-2269. 6 Refs.

Under loading, fiber composites undergo a long stage of three-dimensional fracture (multiple fiber fractionation), with fiber ruptures leading to structural changes in the matrix whose dimensions are comparable with the distance between fibers. The interaction between damage centers and their effect on damage accumulation in a loaded fiber composite is examined here with reference to a specific example. The analysis allows for the effect of neighboring fiber overloading due to cracks in the matrix caused by fiber rupture.

A89-27397 Modeling of the imperfectly elastic properties of composite materials (Modelirovanie nesovershenno-uprugikh svoistv kompozitnykh materialov). V. G. DUBENETS, *Problemy Prochnosti* (ISSN 0556-171X), Dec. 1988, pp. 81-86.

Governing equations for a quasi-homogeneous composite material are obtained which allow for the microstructure and imperfectly elastic properties of the components. The equations are intended for the mathematical modeling of structures exposed to dynamic loading.

A89-27381 Fracture toughness of carbon-composite structural elements (Treshchinostoikost' ugleplastikovykh elementov konstruktsii). A. E. USHAKOV, *Fiziko-Khimicheskaia Mekhanika Materialov* (ISSN 0430-6252), Vol. 24, Nov.-Dec. 1988, pp. 81-87.

The paper is concerned with some aspects of using linear composite fracture mechanics in analytical and experimental studies of the fracture toughness and residual strength of structural elements made from carbon composites. Particular attention is given to methodological problems associated with the use of a two-parametric model of composite fracture mechanics and equations for determining the critical stress intensity factor with allowance for the variability of composite fracture modes. A comparison is made between analytical and experimental results obtained for carbon plastics with different layup patterns.

A89-21484 Proof of a continuum fracture theory for the compression of metal-matrix layered composites (Obosnovanie kontinual'noi teorii razrusheniia pri szhatii sloistykh kompozitnykh materialov s metallicheskoi matritsei). A. N. GUZ' and I. A. GUZ', *Prikladnaia Mekhanika* (ISSN 0032-8243), Vol. 24, Nov. 1988, pp. 9-16. 11 Refs.

By using an approach previously proposed for brittle fracture mechanics, a continuum fracture theory under compression is developed for the case of ductile fracture of metal-matrix layered composites. The theory is proved for the plane problem for layered composites consisting of alternating layers of a metal matrix and a filler. The proof is based on results obtained in the context of a piecewise homogeneous medium using a three-dimensional linearized stability theory for elasticplastic bodies under small subcritical deformations.

A89-26262 Strength and defects of composites. A. A. BERLIN, S. L. BAZHENOV, A. M. KUPERMAN, and E. S. ZELENSKII, *Composite materials and structures; Proceedings of the International Conference*, Madras, India, Jan. 6-9, 1988 (A89-26251 09-39). New Delhi, Tata McGrawHill Publishing Co., Ltd., 1988, pp. 121-126. 9 Refs.

The effects of stress concentrators on the strength of composites with elastic and plastic matrices can differ significantly; stress concentration is substantially lower in the case of a plastic matrix than an elastic one. For a given matrix type, the greater the fiber modulus of elasticity, the higher the stress concentration, and the more plastic the matrix must be in order to maintain the level of the material's sensitivity to such defectrelated parameters as fracture energy.

A89-26097 Effect of secondary cracks on the stability and growth of delaminations in composite structures (Vliianie vtorichnykh treshchin na ustoichivost' i rost otsloenii v konstruktsiiakh iz kompozitov). G. KH. MURZAKHANOV and V. N. SHCHUGOREV, *Mekhanika Kompozitnykh Materialov* (ISSN 0203-1272), Nov.-Dec. 1988, pp. 1120-1124. 5 Refs.

Analytical and experimental data are presented on the growth of edge delaminations in composites in the presence of secondary cracks in the delamination region. The stability of the delaminations and secondary cracks is analyzed in the sense of Euler (elastic stability) and Griffith (fracture mechanics). The theoretical treatment is based on multiparametric fracture mechanics models.

A89-35665 Delayed fractureof a block of a viscoelastic composite material with a plane disk-shaped crack (Dlitel'noe razrushenie massiva iz viazkouprugogo kompozitsionnogo materiala s ploskoi krugovoi treshchinoi). A. A. KAMINSKII and S. A. KEKUKH, *Prikladnaia Mekhanika* (ISSN 0032-8243), Vol. 25, Feb. 1989, pp. 66-75. 6 Refs.

The paper is concerned with the slow subcritical growth of a plane disk-shaped macrocrack of the normal tearing type in a block of a composite material consisting of system of mutually orthogonal rectilinear isotropic elastic fibers and an isotropic viscoelastic matrix. Expressions are obtained which determine the safe level of external loads, crack growth kinetics, and the life of the composite block.

A89-21596 Stress-strain state of layered composite shells (Napriazhenno-deformirovannoe sostoianie obolochek iz sloistykh kompozitov). G. M. KULIKOV, *PMTF Zhurnal Prikladnoi Mekhaniki i Tekhnicheskoi Fiziki* (ISSN 0044-4626), Sept.-Oct. 1988, pp. 157-162. 11 Refs.

A nonlinear version of the theory of multilayer anisotropic shells in which the order of the resolvent system of differential equations depends on the number of layers is developed in arbitrary curvilinear coordinates. Local effects in cross-reinforced cylindrical shells are investigated. The results obtained are compared with results based on linear elasticity theory and two refined theories for Timoshenko shells.

Japanese Aerospace Literature
This month: *Fracture Mechanics of Composite Materials*

A90-18391 Near-threshold transverse fatigue crack growth characteristics of unidirectionally continuous fiber reinforced metals. K. HIRANO, *Proceedings of the 4th Japan-U.S. Conference on Composite Materials*, Washington, DC, June 27-29, 1988, (A90-18351 06-24). Lancaster, PA, Technomic Publishing Co., Inc., 1989, pp. 633-642. Research supported by MITI. 10 Refs.

Transverse fatigue crack growth tests under both Mode I and mixed mode (Mode I, II) loading conditions were conducted on unidirectional continuous SiC (CVD) fiber reinforced 6061 Al alloy matrix composite over a wide range of fatigue crack growth rates covering the threshold stress intensity factor range. The transverse fatigue crack growth characteristics were evaluated on the basis of linear elastic fracture mechanics. The fatigue crack growth mechanism was also investigated based on fractographic examinations. It is found that the transverse fatigue crack growth characteristics were successfully presumed from both that of the matrix metal and fracture toughness.

A90-15721 Thermal shock fracture behaviour of ZrO2 based ceramics. M. ISHITSUKA, T. SATO, T. ENDO, and M. SHIMADA, *Journal of Materials Science* (ISSN 0022-2461), Vol. 24, Nov. 1989, pp. 4057-4061. 17 Refs.

Thermal shock fracture behavior of alumina, mullite, silicon carbide, silicon nitride and various kinds of zirconia-based ceramics, such as magnesia partially stabilized zirconia (Mg-PSZ), yttria and ceria-doped tetragonal zirconia polycrystals (Y-TZP and Ce-TZP), Y-TZP/Al2O3 composites and yttria-doped cubic stabilized zirconia (Y-CSZ), was evaluated by the quenching method using water, methyl alcohol and glycerin as quenching media. Thermal shock fracture of all materials seemed to proceed by the thermal stress due to convective heat transfer accompanied by boiling of the solvents under the present experimental conditions. Thermal shock resistance of zirconia-based ceramics increased with increasing the fracture strength, but that of Y-TZP and Y-TZP/Al2O3 composites was anomalously lower than the predicted value.

A90-18371 Degradation damage mechanisms of epoxy matrix composites exposed to high-energy electron irradiation. N. TAKEDA, K. TAKAHASHI, and M. TOHDOH, *Proceedings of the 4th Japan-U.S. Conference on Composite Materials,* Washington, DC, June 27-29, 1988, (A90-18351 06-24). Lancaster, PA, Technomic Publishing Co., Inc., 1989, pp. 331-338. 18 Refs.

The degradation properties of epoxy based FRP composites irradiated by high-energy electrons were studied using the Mode II interlaminar fracture toughness G(IIc), measured by end-notched flexure tests. The radiation-induced degradation mechanisms were investigated through G(IIc) and the SEM of fracture surfaces. For GFRP, the significant decrease in G(IIc) was found. Debonding of glass fibers and epoxy matrix (or degradation of silane coupling agents) plays an important role in degradation in addition to resin degradation. Thus, the improvement of the radiation resistance of fiber-resin interfaces as well as matrix itself is of supreme importance in order to increase the radiation resistance of GFRP. For CFRP, on the other hand, no degradation in fiber-resin interfaces was found, and the slight decrease in G(IIc) seems to be due to resin brittleness. The sensitivity of radiation-induced degradation was more pronounced in the Mode II interlaminar fracture toughness than in the interlaminar shear strength, for both GFRP and CFRP. Consequently, interlaminar fracture toughness measurements were found necessary for proper evaluation of the radiation-induced degradation of FRP composites.

A90-13227 Mechanical properties of alumina/silicon carbide whisker composites. SATOSHI IIO, MASAKAZU WATANABE, MASARU MATSUBARA, YASUSHI MATSUO, *American Ceramic Society Journal* (ISSN 0002-7820), Vol. 72, Oct. 1989, pp. 1880-1884. 10 Refs.

The improvement of mechanical properties of Al2O3/SiC whisker composites has been studied with emphasis of the effects of the whisker content and of the hot-pressing temperature. Mechanical properties such as fracture toughness and fracture strength increased with increasing whisker content up to 40 wt pct. In the case of the high SiC whisker content of 40 wt pct, fracture toughness of the sample hot-pressed at 1900 C decreased significantly, in spite of densification, compared with one hot-pressed at 1850 C. Fracture toughness strongly depended on the microstructure, especially the distribution of SiC whiskers, rather than the grain size of the Al2O3 matrix.

A90-15711 Stress disturbance due to broken fibres in metal matrix composites with nonuniform fibre spacing. SHOJIRO OCHIAI and KOZO OSAMURA, *Journal of Materials Science* (ISSN 0022-2461), Vol. 24, Nov. 1989, pp. 3865-3872. 5 Refs.

Premature fracture of weaker fibers causes stress disturbances in composites. These disturbances are affected by non-uniformity of fiber spacing. In order to evaluate quantitatively how the disturbances in metal matrix composites are affected by the extent of non-uniformity of fiber spacing, a method of calculation is presented on the basis of two-dimensional shear lag analysis. Static tensile stress concentrations in the intact fibers to broken fibers, tensile stress distribution along the fiber axis in the broken and intact fibers and shear stresses between broken and intact fibers were calculated by the method presented, using some examples. It is shown quantitatively that the spacing between broken and intact fibers and that between intact and next fibers has a significant influence on tensile stress concentrations in intact fibers and also on the shear stresses between broken and intact fibers; the narrower the former spacing and the wider the latter spacing, the higher become both tensile and shear stress concentrations. This tendency is enhanced when the number of broken fibers is large and when the strain hardening of the matrix is high.

A89-40813 Free-edge delamination of anisotropic composite laminates. II Experimental approach. TAKAHIRA AOKI, TOMOAKI KUBO, and KYOHEI KONDO, *Japan Society for Aeronautical and Space Sciences Journal* (ISSN 0021-4663), Vol. 37, no. 422, 1989, pp. 144-154. 21 Refs.

Experimental approaches to free-edge delamination onset and growth are presented in combination with strain energy release rate calculations. Cross-ply and quasi-isotropic carbon-epoxy laminates are subjected to tension-tension and compression-compression fatigue loads and the interfaces at which delamination occurs are compared with predictions. The excellent agreement show the existence of loading direction effects and initial defects. Quasi-isotropic carbon-epoxy laminates with different thicknesses are tested under static tensile loads. The delamination onset strains of the laminates with and without detectable initial delaminations are measured and used to calculate the energy release rates as a function of the delamination length, and the length of undetectable initial defects is obtained. Static tensile tests of carbon-epoxy laminates with simulated initial delaminations are conducted to obtain the critical strain energy release rates. The contribution of opening and shear mode energy release rates on the onset of delamination are studied.

A89-38070 The constitutive equations of metal matrix composites. FUMIKI TOMIOKA, JYUNICHI HAMANAKA, and HIROSHI OHYA, *Proceedings of the 16th International Symposium on Space Technology and Science,* Sapporo, Japan, May 22-27, 1988, Vol. 1 (A89-38031 16-12). Tokyo, AGNE Publishing, Inc., 1988, pp. 337-343. 5 Refs.

The constitutive equations of unidirectionally fiber reinforced metals and laminated plates were derived. Static and Dynamic tensile testings were performed on unidirectional boron/aluminum composites and cross-ply laminated plates. The validity of proposed constitutive equations was confirmed by comparing the calculated results with the experimental ones.

A90-17764 Characteristics of hot-pressed fiber-reinforced ceramics with SiC matrix. TADAHIKO MIYOSHI, HIRONORI KODAMA, HIROSHI SAKAMOTO, AKIHIRO GOTOH, and SHIROO IIJIMA, *Metallurgical Transactions A—Physical Metallurgy and Materials Science* (ISSN 0360-2133), Vol. 20A, Nov. 1989, pp. 2419-2423.16 Refs.

Silicon carbide ceramics' matrix composites with SiC or C filaments were fabricated through hot pressing, and the effects of the filament pullout on their fracture toughness were experimentally investigated. The C-rich coating layers on the SiC filaments were found to have a significant effect on the frictional stress at the filament/matrix interfaces, through assisting the filament pullout from the matrix. Although the coating layers were apt to burn out in the sintering process of SiC matrix composites, a small addition of carbon to the raw materials was found to be effective for the retention of the layers on the fibers, thus increasing the fracture toughness of the composites. The fracture toughness of the C filament/SiC matrix composite increased with temperature due to the larger interfacial frictional stress at higher temperatures, because of the higher thermal expansion of the filament in the radial direction than that of the matrix.

A89-42979 Internal friction, crack length of fracture origin and fracture surface energy in alumina-zirconia composites. T. ONO, K. NAGATA, M. HASHIBA, E. MIURA, Y. NURISHI et al., *Journal of Materials Science* (ISSN 0022-2461), Vol. 24, June 1989, pp. 1974-1978. 11 Refs.

Two series of alumina-zirconia composites, i.e. aluminaunstabilized zirconia and aluminapartially stabilized zirconia with 3 mol pct Y2O3, with different zirconia content were slip-cast and fired at 1550 C for 3 h. Elastic constant, bending strength and fracture toughness were measured. Internal friction was determined to follow the formation of cracks, nondestructively, which could be one of the fracture origins. The crack length of the fracture origin and the fracture surface energy were calculated by applying Griffith's fracture theory. Microstructures of the fracture surfaces were observed using SEM. For the unstabilized zirconia system, the increase in the internal friction was a guide to the formation of cracks which lead to the fracture. The cracks becoming fracture origins lead to the increase in K(Ic) and also to the apparent increase in the fracture surface energy. For the partially stabilized zirconia system, the increase in the fracture surface energy with an increase in zirconia content, keeping low internal frictions indicates the intrinsic strengthening of the grain boundaries in comparison to the unstabilized zirconia system. Internal friction is the most suitable nondestructive physical quantity to find the microcracks which lead to fracture.

A89-41727 Failure behaviors of cylindrical adhesively bonded joints of FRP under combined bending and torsional loadings. KATSUHIKO OSAKA, TAKEHITO FUKUDA, and AKIHISA KOIZUMI, *Japan Society of Materials Science Journal* (ISSN 0514-5163), Vol. 38, April 1989, pp. 354-359.

The failure behavior and the strength of cylindrical adhesively bonded joints of fiber reinforced plastics (FRPs) were investigated under combined bending and torsional loading conditions, using an apparatus capable of applying bending and torsional moments in various proportions. Results indicated that the failure criterion of cylindrical joints of FRPs under combined bending and torsional loadings can be expressed by an elliptic-form equation. Measurements on strains and acoustic emission in tensile, bending, torsional, and combined bending and torsional loading tests indicated that the failure of cylindrical adhesive joints was mainly due to the failure in the adhesive layer under tensile loading. Under other loading conditions, damage was in the adherent.

A89-40078 Effects of mechanical properties of matrix on strength of SiC fiber reinforced aluminum base composite metals. YUTAKA KAGAWA and BAE HO CHOI, *Japan Institute of Metals Journal* (ISSN 0021-4876), Vol. 53, March 1989, pp. 339-348. 24 Refs.

The effects of mechanical properties of a matrix on the tensile strength and fracture toughness of SiC-fiber-reinforced composites with commercially pure aluminum matrix (SiC/CPAl) and aluminum alloy matrix (SiC/A384) were investigated using both unnotched and notched specimens in tension tests. It was found that the tensile strength and the fracture toughness of SiC/CPAl increased with increasing fiber fraction, while those of SiC/A384 decreased. In both composites, there was a strong correlation between tensile strength and fracture toughness. Results suggest that a difference of the fracture behavior between the two composites was due to the difference of the stress relaxation mechanism following the initial fracture of weak fibers in the matrix.

A89-31074 Fracture resistance of a TiB2 particle/SiC matrix composite at elevated temperature. MICHAEL G. JENKINS, JONATHAN A. SALEM, and SRINIVASA G. SESHADRI, *Journal of Composite Materials* (ISSN 0021-9983), Vol. 23, Jan. 1989, pp. 77-91. Previously announced in STAR as N88-26482. 23 Refs.

The fracture resistance of acommercial TiB2 particle/SiC matrix composite was evaluated at temperatures ranging from 20 to 1400 C. A laser interferometric strain gauge (LiSG) was used to continuously monitor the crack mouth opening displacement (CMOD) of the chevron-notched and straightnotched, threepoint bend specimens used. Crack growth resistance curves (R-curves) were determined from the load versus displacement curves and displacement calibrations. Fracture toughness, work-of-fracture, and R-curve levels were found to decrease with increasing temperature. Microstructure, fracture surface, and oxidation coat were examined to explain the fracture behavior.

A89-40077 Thermal cycling behavior of carbon fiber-reinforced Al alloy with SiC particulates and whiskers. HAJIME IKUNO, SHINICHI TOWATA, and SENICHI YAMADA, *Japan Institute of Metals Journal* (ISSN 0021-4876), Vol. 53, March 1989, pp. 327-332. 9 Refs.

The effects of the hybrid technique and the alloying element Mg on the thermal cycling behavior of hybrid fiber-reinforced Al-5 percent Mg alloys, in which SiC particulates and whiskers were distributed among the continuous fibers, was investigated by measuring the residual expansion and the transverse strength after thermal cyclings between room temperature and 573 K. After thermal cycling of 1000 times, about 1 percent of strain of transverse residual expansion was observed, in addition to a large number of cracks between fibers and the matrix. As compared with the nonhybrid composites, in which the transverse strength was gradually degraded during thermal cycling (from 45 to 30 MPa), the transverse strength of the hybrid composites sharply fell during thermal cycling, from 100 to 80 MPa. Fewer fibers debonded from the matrix of hybrid composites on transverse fracture surfaces than in the case of nonhybrid composites.

A89-33179 Mechanical properties of SiC whisker reinforced aluminum alloys fabricated by pressure casting method. TOSHIRO KOBAYASHI, MASAKI YOSINO, HIROYOSHI IWANARI, MITSUO NIINOMI, and KUNJI YAMAMOTO, *Cast reinforced metal composites; Proceedings of the International Symposium on Advances in Cast Reinforced Metal Composites*, Chicago, IL, Sept. 26-30, 1988 (A89-33151 13-24). Metals Park, OH, ASM International, 1988, pp. 205-210. 10 Refs.

Microstructures and mechanical properties of SiC whisker (SiCw) reinforced aluminum alloys fabricated by pressure casting method are investigated. The SiCw-reinforced aluminum alloys fabricated under the pressure of 90 MPa are superior to those fabricated under lower pressure conditions in mechanical properties. The fracture of SiCw-reinforced aluminum alloys is associated with the failure of SiCw and the interface decohesion between whiskers and matrix. It is shown that these composites are strengthened by increasing interface bonding between SiCw and matrix, i.e., the interface cohesion is strengthened by accelerating the interface reaction adequately. The addition of the highly reactive lithium to aluminum matrix makes the interface cohesion tight and results in lower density and greater strength composites.

A89-29610 Further damages of transverse cracks occurring in the cross-ply composite. H. OHIRA, T. SHONO, and N. UDA, *Mechanical behaviour of materials—V; Proceedings of the Fifth International Conference*, Beijing, People's Republic of China, June 3-6, 1987. Vol. 2 (A89-29551 11-39). Oxford and New York, Pergamon Press, 1988, pp. 1205-1212. 9 Refs.

The new experimental stress/strain diagram presented for a (0, 90 sub 10, 0) glass fiber-reinforced epoxy laminate under tension is divisible into three phases, of which the first is elastic, the second is characterized by transverse cracking, and the third is governed by further damage due to the second phase's transverse cracks. The damage may develop with increasing load; the possibility of such damage from phase three is investigated theoretically, in light of brittle secondary failure. Several shapes are assumed for the failure process and possible alleviating mechanisms for stress concentration.

A89-21086 Mechanical properties of GFRP composite materials at cryogenic temperatures. TETSUYA TAKAAI, KAZUHITO SANO, and EIJI FUKUSHIMA, *Japan Society of Materials Science Journal* (ISSN 0514-5163), Vol. 37, Oct. 1988, pp. 1185-1190. 9 Refs.

Mechanical properties of GFRP composite materials were studied using smooth, holed, and notched tensile specimens at cryogenic temperatures ranging from 77 to 293 K. The maximum tensile fracture stress of the specimens increased almost linearly with decreasing test temperature and was related to the cross head speed by an exponential function at each test temperature. The cross head speed sensitivity exponent of holed specimens had relatively higher values than those of smooth and notched specimens. The notch tensile ratios of the holed and notched specimens were relatively higher by 200 to 300 percent than values estimated based on the stress concentration factor. The measured maximum fracture stress of the GFRP composite materials is discussed and compared with calculated values, and good agreement is found.

A89-18770 Hightemperature mechanical properties of high toughness metallic filament composites with polyimide and epoxy matrices. TOMOKO GOTO and HISAYUKI TSUBOUCHI, *Journal of Materials Science* (ISSN 0022-2461), Vol. 23, Oct. 1988, pp. 3630-3635.

High toughness metallic filament was produced by glasscoated melt spinning. The high temperature mechanical properties of the composite consisting of the filaments uniaxially aligned in polyimide and epoxy matrices were investigated at the temperature range from 423 K to 573 K. The Young's modulus of the composite, E(c) of the polyimide composite at temperatures up to 573 K was higher than that predicted by the linear function of the filament content, V(f), and the filaments fractured tightly in contact with the matrix. The epoxy resin composite had an excellent high temperature mechanical properties in spite of the low T(g) of the resin and large thermal expansion mismatch between the filaments and the resin. The value of E(c) at 573 K was higher than that of a linear function of the V(f) and tensile strength of the composite at 573 K agreed with the simple law of mixture. It is considered that some heat reaction of the resin occurred by incorporating the metallic filaments.

A89-16319 An analysis of theT-shaped crack along the fiber-matrix interface in unidirectional composite materials. WENXUE WANG, YOSHIHIRO TAKAO, and TOSHIRO SUHARA, *JSME International Journal, Series I* (ISSN 0914-8809), Vol. 31, Oct. 1988, pp. 709-717. 21 Refs.

Afracture problem in unidirectionally fiber-reinforced composites containing a T-shaped crack at the interface is considered. The T-shaped crack consists of an interface crack and a crack perpendicular to the interface. A system of integral equations is formulated based on the two-dimensional elasticity and Fourier transforms. The integral equations are evaluated by a numerical method using only the Gauss-Chebyshev integral formula, which was developed by the present authors in the last paper. First, the numerical results are compared with the previous results for a T-shaped crack in a homogeneous material, verifying the present method to be highly satisfactory. Next, three kinds of stress intensity factors (SIFs), such as Model SIF of a perpendicular crack and Mode I and II SIFs of an interface crack, are presented for glass/epoxy, carbon/epoxy and tungsten/copper composite systems with various geometrical parameters.