

A69-16498 Fabrication of potassium titanate whisker/aluminum composites and some of their properties. YOSHIMORI NISHIDA, TSUNEMICHI IMAI, MAMORU YAMADA, HIROMI MATSUGATA, and TARU SHIRAYANAGI, Japan Institute of Light Metals Journal (ISSN 0451-7594), Vol. 38, Sept. 1988, pp. 515-521, 12 Refs.

Abstract: The mechanical properties of aluminum matrix composites reinforced with potassium titanate whiskers were investigated. The whiskers were fabricated by squeeze casting. The reaction of aluminum composites fabricated by squeeze casting. The reaction of whiskers to molten metals can be prevented by rapid solidification. No degradation of whiskers and their planar random array in the composites are revealed by electron probe microanalysis. One of the most significant features of the composites is excellent machinability by the use of ordinary

A89-20934 Effects of hot extrusion and rolling on the tensile strength of SiC whisker reinforced aluminum alloy composites. HIDEO WATANABE, KOICHI OHORI, and YO TAKEUCHI, *Japan Institute of Light Metals Journal* (ISSN 0451-5994), Vol. 38, Oct. 1988, pp. 633-639, 15 Refs.

SiC whisker/Al composites fabricated by high pressure infiltration were extruded and rolled at high temperatures. Measurements were taken of the strength and working ratio of the composites. It is found that the tensile properties of extruded composites are strongly dependent on the whisker orientation. The elastic modulus of SiC whisker/6061 composites is expressed as $E = 255 V_f + 72$ (GPa).

A89-20926 Mechanical properties of SiC whisker reinforced aluminum alloys. MASAKI YOSHINO, HIROYOSHI IWANARI, MITSUO NIINOMI, and TOSHIRO KOBAYASHI, *Japan Institute of Light Metals Journal* (ISSN 0451-5994), Vol. 38, Oct. 1988, pp. 593-599, 10 Refs.

The paper presents an analysis of the mechanical properties of silicon-carbide-whisker-reinforced (SCWR) aluminum alloys fabricated using the pressure casting method. The SCWR aluminum alloys fabricated at a pressure of 90 MPa are found to be mechanically superior to those fabricated at a lower pressure. The failure of SCWR aluminum alloys is associated with the failure of the silicon carbide whiskers and the interface decohesion between the whiskers and the matrix.

A89-19887 Variations of tensile and flexural strengths of advanced fiber reinforced plastics. MITSUNORI MIKI, YOSHISADA MUROTSU, and TOSHIHIKO SAKAI, *Japan Society of Materials Science Journal* (ISSN 0514-5163), Vol. 37, Sept. 1988, pp. 1022-1028, 6 Refs.

A database for the mechanical properties of advanced composites was developed. The data were obtained from the research and development project of composite materials for future industries supported by the Ministry of International Trade and Industry. This paper deals with the statistical analysis of the tensile and flexural strengths of fiber reinforced plastic (FRP) based on this data-base. The present analysis consists of the following parts: (1) the calculation of basic statistical properties, the calculation of parameters of Weibull distribution, and the testing of goodness-of-fit for the primary populations where the sample size is larger than ten; (2) the clarification of the effects of various factors such as hybridization, discontinuousness of fibers, temperature, thermal aging, orientation, and matrix properties on the mean strength and the variation; and (3) the clarification of statistical properties of the parameters of the strength distributions.

A89-14591 Evaluation of strength of SiC fiber reinforced aluminum composite material. AKIMITSU OKURA and TATSUNORI IDE, *IN: Interfaces in polymer, ceramic, and metal matrix composites; Proceedings of the Second International Conference on Composite Interfaces (ICCI-II)*, Cleveland, OH, June 13-17, 1988 (A89-14551 03-24). New York, Elsevier, 1988, pp. 643-656, 7 Refs.

The strength characteristics of SiC monofilaments are evaluated using Weibull statistics, and then a similar procedure is used to evaluate the strength of a SiC/Al preform wire produced by coating SiC fibers with commercial aluminum. The results obtained demonstrate the applicability of Weibull statistics to the dispersion of SiC fiber strength and the dependence of the strength on the gauge length. In the case of preform wire, Weibull statistics are also applicable to the relationship between the sample volume and the mean strength.

A88-41790 Mechanical properties of carbon fiber-reinforced aluminum alloys with whiskers and particulates of silicon-carbide. SHIN-ICHI TOWATA, HAJIME IKUNO, and SEN-ICHI YAMADA, *Japan Institute of Metals Transactions* (ISSN 0021-4434), Vol. 29, April 1988, pp. 314-321, 18 Refs.

New types of carbon fiber-reinforced aluminum alloys, in which whiskers and fine particulates of silicon-carbide were distributed among the fibers, were prepared by a squeeze casting process, using low cost high-strength-type carbon fibers. The mechanical properties and fracture morphologies of the composites were investigated by the three-point flexural tests with acoustic emission measurements. The results obtained are as follows. In the conventional composites, the longitudinal flexural strength was very low, and the failure of the fibers was initiated mainly at the point of direct fiber-to-fiber contacts. On the other hand, the longitudinal flexural strength of the hybrid composite was about 50 percent higher than that of the conventional composites. In the hybrid composites, the fibers were separated by whiskers and particulates. The failure occurred after accumulation of microcracks of fiber break.

A88-53404 Fabrication of C/C composite into thick board. EIICHI YASUDA, YASUHIRO TANABE, and KENSHI TANIGUCHI, *Research Laboratory of Engineering Materials Report* (ISSN 0385-3799), no. 13, 1988, pp. 113-119. Document Type: JOURNAL ARTICLE Techniques for the fabrication of carbon-fiber-reinforced carbon composites (C/C composites) with thick body were studied. Two types of fibers, long fiber and short fiber, and thermosetting furan resin as a matrix precursor were used to prepare C/C composites of three kinds of fiber orientation. Two methods were tried in this study; one was hot-pressing carbonization, the other was bonding lay-up. It was observed that increasing the applied hot-pressing pressure resulted in a decrease of horizontal crack or a shape change in the composite. Laid-up samples remained bonded after carbonization at 1000 C, with the exception of one case in which samples were taken apart because of large difference of the thermal expansivities or shrinkage.

A89-13495 A Monte-Carlo simulation of the tensile behaviour of metal matrix composites containing fibres with different diameters. SHOJIRO OCHIAI and KOZO OSAMURA, *Zeitschrift fuer Metallkunde* (ISSN 0044-3093), Vol. 79, Sept. 1988, pp. 605-609, 6 Refs.

The tensile behavior of metal matrix composites, in which the diameter of fiber is not uniform, was studied using a two-dimensional model composite by means of a Monte-Carlo simulation technique. It was found that the tensile strength of composites whose fiber diameter is not uniform is lower than that of composites with uniform fiber diameter. The strength of the composites is strongly affected by the non-uniformity of the fiber diameter, the yield stress of matrix and the scatter of fiber strength. The results were explained in terms of the critical length of broken fibers and the stress concentration factors in the fibers adjacent to broken fibers.

A89-14588 Interfacial effect on fracture process by tensile stress in glass fiber-epoxy composites. N. IKUTA, Z. MAEKAWA, H. HAMADA, S. YOSHIOKA, E. NISHIO et al., *IN: Interfaces in polymer, ceramic, and metal matrix composites; Proceedings of the Second International Conference on Composite Interfaces (ICCI-II)*, Cleveland, OH, June 13-17, 1988 (A89-14551 03-24). New York, Elsevier, 1988, pp. 611-619, 16 Refs.

Results of an experimental study of the effect of a treatment with a silane coupling agent on the fracture behavior of a single glass filament embedded in an epoxy matrix are reported. The fracture process is characterized in terms of mean fragment length, variation coefficient of the fragment length, and fracture position along the fiber length. It is shown that the reinforced interface gives rise to a stress concentration near the fiber fragment ends, increasing the probability of another fracture near the ends. The results obtained are compared with those of a finite element simulation of the fracture process.

A88-49850 Mechanical properties and wear resistance of aluminum alloy 6061 composites reinforced by Al₂O₃ fiber and SiC whisker. THAN TRONG LONG, TAKANOBU NISHIMURA, TATSUYOSHI AISAKA, MICHIOHITO OSE, and MIKIO MORITA, *Japan Institute of Metals Journal* (ISSN 0021-4876), Vol. 52, June 1988, pp. 609-615, 16 Refs.

The mechanical properties and wear resistance of Al₂O₃ fiber and hybrid of Al₂O₃ and SiC whisker-reinforced AA6061 were investigated. Expressions are obtained for the elastic modulus of T6-heat treated Al₂O₃/6061 and Al₂O₃-SiC/6061 composites. The fiber rearrangement coefficients for Al₂O₃ and SiC whisker are given. The wear resistance of Al₂O₃/6061 composites is inferior to that of SiC/6061 composites. The addition of small volume fractions of SiC whisker to Al₂O₃/6061 composites gives rise to remarkable improvement of the wear resistance which is, on the contrary, superior to that of SiC/6061 composites.

A88-45324 Fabrication fiber reinforced metal using a superplastic Zn-(22 percent)Al alloy. YASUO UCHIYAMA, MASAYUKI HASAKA, HIDETO KOGA, and SINYA SATO, *Japan Institute of Metals Journal* (ISSN 0021-4876), Vol. 52, May 1988, pp. 517-522, 24 Refs.

To examine the application of fine-grain superplasticity for the fabrication of fiber-reinforced metal-matrix composites, stainless steel wire of 200-micron diameter and SiC fiber of about 15-micron diameter were consolidated with a matrix metal of Zn-22(mass pct)Al alloy by hot pressing in air at 373-473 K for 3.6 ksec under the load of 7.85-39.2 kN. Being consolidated with a single wire or fiber, the matrix metal flowed around the wire or fiber. The bonding strength of reinforcement-matrix interface was 22.7 MPa when the wire was consolidated at 473 K under the load of 39.2 kN. When an SiC fiber tow was consolidated with the alloy, composites were obtained under all the consolidating conditions studied, except at low temperatures and low consolidating loads. At elevated temperatures and high consolidating loads, the fibers of tow were widely spread with the flow of matrix metal and had a tendency to come into line. (Author)

A88-44422 Fiber bridging effect on opening-mode crack extension resistance of unidirectional fiber-reinforced composites. HIDEKI SEKINE and SHOJI KAMIYA, *Japan Society of Materials Science Journal* (ISSN 0514-6163), Vol. 37, May 1988, pp. 505-510, 9 Refs.

A fiber bridging model is presented which can account for the opening-mode crack extension behavior parallel to the fibers in unidirectional fiber-reinforced composites. A model of the single-fiber-bridging formation process is used to characterize the forces acting on the crack surfaces through the bridging fiber and the relationship between crack opening displacement and the equivalent cohesive stress which is due to a large number of bridging fibers. Simulated results on crack extension behavior are found to be in good agreement with experimental results obtained for a unidirectional epoxy-matrix GFRP.

A89-10603 Influence of inter-fiber spacing on the yield stress of Al-Al₃Ni eutectic composites. OSAMU YANAGISAWA and TETSUO YANO, *Japan Institute of Metals Transactions* (ISSN 0021-4434), Vol. 29, July 1988, pp. 580-588, 19 Refs.

The microstructures of Al-Al₃Ni eutectic composites produced at various solidification rates were examined by the back-reflection Laue X-ray method, and the 0.2-percent proof stress was measured by tensile and compressive tests. Tensile and compressive proof stresses are found to be different even for specimens obtained at the same solidification rate, which is ascribed to the effect of residual stresses. The proof stress is shown to be affected by interfiber spacing and, to a lesser degree, by the cell density. The residual stress, estimated from the proof stress and from the rule of mixtures, is also shown to depend on the interfiber spacing.