

A91-48519 TEM study of a superplastically deformed Ni3Al alloy doped with boron. R. Z. VALIEV, R. M. GAIANOV, H. S. YANG, and A. K. MUKHERJEE, *Scripta Metallurgica et Materialia* (ISSN 0956-716X), Vol. 25, Aug. 1991, pp. 1945-1950. Research supported by AN SSSR. 24 Refs.

The superplastic deformation of a boron-doped Ni3Al alloy at 1373 K was investigated by transmission electron microscopy. It is found that many of the structural changes typical of conventional superplastic metals and alloys are observed during the superplastic deformation of Ni3Al. These include strain induced grain growth, a very small degree of grain elongation, and the presence of a dislocation structure. The superplastic flow of the alloy is associated with grain boundary sliding, intragranular dislocation activity, and diffusion.

A91-47528 Prospects of using rare-earth gadolinium-dysprosium alloys as the working media of refrigerators (Perspektivnost' ispol'zovaniia redkozemel'nykh splavov gadolinii-disprozi i v kachestve rabochikh tel refrizheratorov). G. S. BURKHANOV, S. I. DAN'KOV, S. A. NIKITIN, A. M. TISHIN, and O. D. CHISTIYAKOV, *Pis'ma v Zhurnal Tekhnicheskoi Fiziki* (ISSN 0320-0116), Vol. 17, May 26, 1991, pp. 7-11. 4 Refs.

A comparison of data for various Dy concentrations in Gd(1-x)Dy(x) compounds indicates that the combination Gd0.59(Gd0.30Dy0.10)0.41 will make a suitable working medium for refrigeration systems. This combination can be an effective cooling agent for magnetic refrigerators operating at room temperature.

Japanese Aerospace Literature This month: Alloys

A92-32693 Mechanical properties of aluminum borate whisker reinforced aluminum alloys and interface structure. K. SUGANUMA, G. SASAKI, T. FUJITA, and N. SUZUKI, *Proceedings of the 8th International Conference on Composite Materials, Composites (ICCM/8)*, Honolulu, HI, July 15-19, 1991. Section 12-21 (A92-32535 13-39). Covina, CA, Society for the Advancement of Material and Process Engineering, 1991, pp. 19-D-1 to 19-D-12. 5 Refs.

Specimens of aluminum alloys reinforced by aluminum borate whiskers fabricated by squeeze casting were tested mechanically, and the fiber-matrix interface was examined by transmission electron microscopy. A comparison of the mechanical properties of 6061 alloy matrix composites reinforced with aluminum borate and other types (i.e., silicon carbide, silicon nitride, and potassium titanate) whiskers demonstrates the advantages of the new whiskers. The aluminum borate/aluminum composites have high strength at elevated temperatures, high Young's modulus, and low thermal expansion coefficient. The reaction between aluminum borate whiskers and aluminum alloy is not severe. A thin amorphous-like layer is formed at the whisker-matrix interface.

A92-29569 Ni-base oxide dispersion strengthened alloys for turbine applications. JUN-JI TSUJI, TAKAHITO HOSOKAWA, NORIYASU OGURI, KAZUAKI MINO, and KOICHI ASAKAWA, *Ishikawajima-Harima Engineering Review* (ISSN 0578-7904), Vol. 31, Nov. 1991, pp. 447-451. 3 Refs.

A study has been made on the development of oxide dispersion strengthened (ODS) alloy technologies. An ODS alloy is a hopeful candidate material for turbine components with largely increased inlet temperatures. It is necessary to improve the creep properties at intermediate temperatures as well as high temperatures and also to develop the forming and manufacturing technologies for the practical use of ODS alloys. Various properties, which are important in selecting as a turbine component material, of ODS alloys newly developed were compared with those of single crystals currently in use. Also described were the developmental studies on isothermal forging treatment for directional recrystallization and diffusion bonding technologies which are necessary to produce complicated air-cooled blade and vane structures.

A92-29526 Effect of alloy composition on age-hardening behavior of rapidly solidified Al-Mn-Cr alloys. HEE T. SHIN, JUNICHI KANEKO, and MAKOTO SUGAMATA, *Japan Institute of Metals Journal* (ISSN 0021-4876), Vol. 56, Jan. 1992, pp. 15-22. 18 Refs.

Al-Mn-Cr alloys of various compositions were rapidly solidified into solid solutions of extended solid solubilities, and P/M materials were consolidated from rapidly solidified flakes by cold pressing, vacuum degassing, and hot extrusion. Age hardening behavior was examined for both rapidly solidified flakes and P/M materials. Significant age hardening was observed for the alloys containing 10 mass pct of Mn + Cr. However, extruded P/M materials of these alloys showed higher peak hardness than as rapidly solidified flakes. This thermomechanical effect was observed on age hardening of the alloys containing 10 percent of Mn + Cr, whereas no such effect was observed for the alloys containing 7 percent or less of Mn + Cr. Therefore, the optimum Mn and Cr contents for age hardening of rapidly solidified Al-Mn-Cr alloys are such that the G phase, (Mn, Cr)Al12, is the only constituent phase other than alpha-Al, and thus the Al-8Mn-2Cr alloy showed the highest age hardenability.

A91-38226 Influence of oxygen content on electrical resistivity and phase constitution in quenched Ti-V alloys. MASAHIKO IKEDA, SHIN-YA KOMATSU, TAKASHI SUGIMOTO, and KIYOSHI KAMEI, *Japan Institute of Metals Journal* (ISSN 0021-4876), Vol. 55, March 1991, pp. 260-266. 19 Refs.

The effect of oxygen addition on the specific resistivity and hardness of three series of alloys, Ti-10-40 pct V, Ti-20 pct V, and Ti-30 pct V, quenched from beta-phase range temperatures is studied. X-ray diffraction was used to confirm the phase constitution at the RT. The X-ray phase constitution of Ti-V-0.3 pct alloys showed no significant difference from previous alloy series containing about 0.1 pct O.

A92-29498 Effect of hydrostatic pressures on thermoelastic martensitic transformations in aged Ti-Ni and ausaged Fe-Ni-Co-Ti shape memory alloys. TOMOYUKI KAKESHITA, KEN'ICHI SHIMIZU, SEI NAKAMICHI, RITSU TANAKA, SHOICHI ENDO, and FUMIHISA ONO, *JIM, Materials Transactions* (ISSN 0916-1821), Vol. 33, Jan. 1992, pp. 1-6. Research supported by Osaka University and MOESC. 18 Refs.

The effect of hydrostatic pressures on thermoelastic martensitic transformations in aged Ti-51 at pct Ni and ausaged Fe-31.9Ni-9.8Co-4.1Ti (at pct) shape memory alloys has been investigated by electrical resistivity measurements under hydrostatic pressures up to 1.5 GPa. The results obtained were as follows: transformation temperatures of the B2 = R transformations for two kinds of Ti-Ni alloys aged for short and long periods were independent of pressure. Ms and As temperatures of the successive R - B19-prime transformations were linearly increased with increasing pressure for the short aged Ti-Ni alloy, but remained constant for the long aged one. On the other hand, the Ms and As temperatures in the ausaged Fe-Ni-Co-Ti alloy were inversely decreased with increasing pressure. A thermodynamic analysis on the pressure dependence of the thermodynamic equilibrium temperature, which was obtained from the measured transformation temperatures, showed that the effect of hydrostatic pressures on the B2 - R and R - B19-prime martensitic transformations in the short aged Ti-Ni alloy was successfully explained by a modified Patel and Cohen's equation, but was not for the gamma - alpha-prime transformation in the ausaged Fe-Ni-Co-Ti alloy.

A92-28000 Ultra-fine equiaxed grains obtained by process of hydrogenation, aging and dehydrogenation in alpha + beta type titanium alloys. HIROFUMI YOSHIMURA, KIN'ICHI KIMURA, MASAYUKI HAYASHI, MITSUO ISHII, and JIN-ICHI TAKAMURA, *Japan Institute of Metals Journal* (ISSN 0021-4876), Vol. 55, Dec. 1991, pp. 1375-1381. 13 Refs.

A procedure is described for equiaxed grain refinement in alpha + beta titanium alloys, with particular consideration given to the appearance of two different types of dislocation structures introduced by this procedure. In this procedure, the titanium alloys are hydrogenated with large amounts of hydrogen and dehydrogenated in vacuum at elevated temperatures. Of the two types of dislocation structures, one is introduced by the precipitation of hydrides on aging at relatively low temperature after solution treatment of hydrogenated Ti alloys; the other is introduced by martensitic transformation on cooling from the beta-phase or the alpha + beta two-phase region of hydrogenated titanium alloys. The combination of the two factors results in Ti-6Al-4V alloys exhibiting equiaxed grains of about 1-micron diameter.

A92-21706 Improvement in oxidation resistance of the Ti-31 to 39 mass pct Al alloys by heat treatment under a low partial pressure oxygen atmosphere. MICHIO YOSHIHARA, RYOHEI TANAKA, TETSUYA SUZUKI, and MORIYASU GOTO, *JIM, Materials Transactions* (ISSN 0916-1821), Vol. 32, Nov. 1991, pp. 1017-1023. Research supported by MOESC. 13 Refs.

The oxidation behavior of Ti-31 to 39 mass pct Al and Ti-36 mass pct Al, with various oxygen contents, is presently investigated with a view to the effect of heat treatment under low oxygen partial pressure. Cyclic oxidation tests were conducted at 900 and 950 C in an air atmosphere. It is found that nonheat-treated specimen oxidation behavior depends on Al content, with oxidative mass gain decreasing with rising Al content. At 700 C, TiO2 emerged in alloys with higher oxygen content.

A92-13442 Castability of Al-Li alloys. SEIJI SAIKAWA, SHIGERU SUGIOKA, KIYOSHI NAKAI, YASUO SUGIURA, and AKIHIKO KAMIO, *Japan Institute of Light Metals Journal* (ISSN 0451-5994), Vol. 41, Sept. 1991, pp. 596-601. 10 Refs.

The casting characteristics of Al-3Si-1Mg-0.15Zr (in percent) containing 1, 2, or 3 percent Li were investigated. It was found that Li losses were about 0.1, 0.2, and 0.4 percent for alloys containing 1, 2, and 3 percent Li, respectively, when the alloys were melted and held for 3 ksec at 973 K in air.

A92-29421 Effect of rare-earth elements on the structures and mechanical properties of Mg-8 percent Li alloys. OSAMU TANNO, KIYOKI OHUCHI, KAZUO MATUZAWA, SHIGEHARU KAMADO, and YOKOJIMA, *Japan Institute of Light Metals Journal* (ISSN 0451-5994), Vol. 42, Jan. 1992, pp. 3-9. 16 Refs.

The effect of REE on the structure and mechanical properties of Mg-8 mass pct Li ($\alpha + \beta$) alloys has been investigated. REE formed intermetallic compounds with magnesium. Below 90 percent rolling reduction Mg-Li-REE ternary alloys showed work hardening behavior which is similar to that of Mg-Li binary alloy, while above 90 percent rolling reduction they exhibited the work softening probably due to recovery. Isochronal annealing below 373 K softened cold-rolled Mg-Li-REE alloys. On the other hand, the recrystallization temperature was raised by the addition of REE. Age-hardening due to the precipitation of α phase in β phase was observed in all alloys. Overaging was recognized in Mg-Li binary alloy, whereas not in Mg-Li-REE ternary alloys. These results suggest that RE addition improves the thermal stability of precipitates, resulting in the improvement of elevated temperature strength through aging treatment. The addition of REE tended to increase the tensile strength, but to decrease the elongation.

A92-29424 Effect of 15 percent Si addition on mechanical properties of rapidly solidified Al-Fe and Al-Mn alloys. HEE T. SHIN, MAKOTO SUGAMATA, and JUNICHI KANEKO, *Japan Institute of Light Metals Journal* (ISSN 0451-5994), Vol. 42, Jan. 1992, pp. 38-44. 5 Refs.

Rapidly solidified flakes of six alloys systems (Al-Fe, Al-Mn, Al-Si-Fe, Al-Si-Mn, Al-Si-Fe-Mn and AC8A) were produced by using an apparatus combining atomization and water-cooled single copper roll. Consolidation of the flakes was done by cold pressing, degassing, and hot extrusion. Metallography and mechanical properties were studied in order to evaluate the effect of 15 mass pct Si addition on properties of Al-Fe and Al-Mn base rapidly solidified P/M materials. Tensile strength of Al-Fe P/M materials at room temperature was increased by addition of 15 percent Si, whereas Al-Mn alloys with 15 percent Si addition showed almost same strength as those without 15 percent Si addition. However, elevated temperature tensile strength of the alloys containing 15 percent Si was lower than that of Al-Fe and Al-Mn binary alloys. P/M material of Al-15 percent Si-8 percent Fe alloy showed the highest tensile strength of about 410 MPa at room temperature, and Al-8 percent Fe alloy showed the highest tensile strength of about 140 MPa at 573 K. Ductility of P/M materials was reduced by addition of 15 percent Si.

A92-20495 Fatigue crack growth behaviour in molten-metal processed SiC particle-reinforced aluminium alloys. SHINJI KUMAI, JULIA E. KING, and JOHN F. KNOTT, *Fatigue and Fracture of Engineering Materials and Structures* (ISSN 8756-758X), Vol. 15, Jan. 1992, pp. 1-11. 12 Refs.

The effect of the distributed SiC particles and other constituent particles in aluminum alloy/SiC (2014/5-wt-pct-SiC) composites on the fatigue-crack initiation and subsequent short-crack-growth behavior of this composite was investigated using micrographic observations and the results of four-point bend loading tests. Preferential crack initiation sites were found to be matrix-SiC interfaces and at $(\text{Fe,Mn})_3\text{SiAl}_{12}$ particles. The regime of microstructurally short crack growth persisted from crack initiation to crack depths of about 200 microns. At crack depths greater than 200 microns, the 'short'-crack data at $R = 0.1$ were in good agreement with conventional long-crack data measured at stress ratio $R = 0.2$ and $R = 0.5$, indicating an absence of crack-closure effects in the Paris region.

A92-13443 Effect of mechanical alloying on the properties of rapidly solidified Al-Mn base alloys. HEE T. SHIN, MAKOTO SUGAMATA, and JUNICHI KANEKO, *Japan Institute of Light Metals Journal* (ISSN 0451-5994), Vol. 41, Sept. 1991, pp. 607-613. 19 Refs.

The effect of mechanical alloying (MA) on the properties of rapidly solidified Al-8 percent Mn alloy flakes containing Fe, Cr, Co, Ce, or Fe + Ni was investigated using rapidly solidified alloy flakes (produced by using an apparatus combining atomization and water-cooled single copper roll) which were MA processed for 30 hrs by a high-energy ball mill. Results indicate that the hardness, strength, and thermal stability of rapidly solidified Al-8Mn alloy were improved by the addition of a third element (with maximum improvement observed in alloy containing 4 percent Co). These properties were further improved by applying MA.

A91-45167 Creep deformation of ductile two-phase alloys. M. TANAKA, H. IIZUKA, and T. SAKAKI, *Acta Metallurgica et Materialia* (ISSN 0956-7151), Vol. 39, July 1991, pp. 1549-1554. 19 Refs.

A continuum mechanics model is developed to explain the creep deformation of ductile two-phase alloys. The model predicts that the transient creep is caused by the internal stresses in second phase and matrix resulting from the difference in creep strain between two phases induced by the strength difference, even if the inherent transient creep in both phases is not taken into account. The difference in creep strain between two phases in steady-state creep is analytically obtained for the alloys in which both second phase and matrix exhibit the exponential law, the power-law or the hyperbolic sine law creep. The continuum mechanics model gives the same values of steady-state creep rate as the contrast creep rate modeled by McDanel's and co-workers. The results of analysis based on the continuum mechanics model are compared with the experimental results.

A92-12019 Hydrogen-solute interaction in nickel-based dilute alloys studied by internal friction technique. O. YOSHINARI, K. SANPEI, and K. TANAKA, *Acta Metallurgica et Materialia* (ISSN 0956-7151), Vol. 39, Nov. 1991, pp. 2657-2665. 34 Refs.

The internal friction has been measured for dilute Ni-M alloys ($M = \text{Ti, Si, Co, Cr, Cu, Fe, Mn, Pd, V}$) containing hydrogen over a temperature range from 60 to 400 K. An internal friction peak due to the interaction between substitutional solute atoms and interstitial hydrogen atoms (S-I peak, SIP) is observed around 160 K except for the Ni-Co alloy. Detailed measurements have been performed on the Ni-Ti alloy; the binding energy for the Ti-H pair, evaluated from the solute and hydrogen concentration dependence of the peak height, is smaller than 2 kJ/mol. The relaxation strength of the SIP is comparable to the Snoek peaks in b.c.c. metals, and is closely related to the dilatation of the host Ni lattice by alloying. Below 120 K, a background internal friction is observed in specimens which show the SIP. The background is explained in terms of the magnetomechanical damping accompanied by the hydrogen reorientation around solute atoms under a static stress due to magnetostriction.

A91-51611 Temperature dependence of mechanical properties at cryogenic temperature in Al-Li-Mg alloys. KEN YAMAMURA, SHIGEOKI SAJI, MASAOKI HISA, and SHIGENORI HORI, *Japan Institute of Light Metals Journal* (ISSN 0451-5994), Vol. 41, Aug. 1991, pp. 515-521. 19 Refs.

The temperature dependence of tensile properties and fracture morphology were investigated at 7-293 K in as-quenched and peak-aged specimens of Al-(2 mass = pct)Li-(0, 1, 2 mass = pct)Mg alloys. The increase in the proof stress with decreasing temperature in the as-quenched specimens was explained in terms of the short-range interactions between dislocations and the solute atoms, whereas the small temperature dependence of the proof stress in the peak-aged specimens was explained in terms of the long-range interactions between dislocations and delta-prime - Al_3Li precipitates. Constant tensile strength at very low temperatures (below about 40 K) was due to the grain boundary fracture.

A91-51606 Age hardening and mechanical properties of rapidly solidified Al-9 pct Zn-2.5 pct Mg-1 pct Cu alloys containing transition metals. SU-GUN LIM, MAKOTO SUGAMATA, and JUNICHI KANEKO, *Japan Institute of Light Metals Journal* (ISSN 0451-5994), Vol. 41, July 1991, pp. 440-445. 10 Refs.

Rapidly solidified flakes of Al-9Zn-2.5Mg-1Cu alloys containing Co, Fe, Mn, and Fe + Ni were produced by atomizing the alloy melt and subsequent splat quenching onto a water-cooled copper single roll. The flakes were consolidated by cold pressing, vacuum degassing, and hot extrusion at a reduction ratio of 25 to 1. Fine and uniform dispersion of transition metal compounds was attained in all P/M materials, and the Mn-bearing alloy showed the greatest hardness, whereas the Co-bearing one exhibited the lowest. The age hardening factor was not affected by the addition of various transition metals; thus the Mn-bearing alloy showed the highest peak hardness. The tensile strength of the T6-treated P/M Mn-bearing alloy was 817 MPa with a 6-wt-pct-Mn addition, and 787 MPa, with 2 wt pct Mn. In T6-treated P/M Mn-bearing alloys, an elastic modulus higher than 82 GPa, a specific elastic modulus higher than 28 GPa, and a specific tensile strength higher than 270 MPa were obtained.

A91-48494 Tensile properties of Ni-base alloys in high pressure hydrogen at room temperature. SEIJI FUKUYAMA, KIYOSHI YOKOGAWA, MICHIO ARAKI, YUKIO KOYARI, and YOSHIO YAMADA, *Japan Society of Materials Science Journal* (ISSN 0514-5163), Vol. 40, June 1991, pp. 736-742. 13 Refs.

The tensile properties of Inconel 718 and Udimet 720 Ni-base alloys being used for liquid hydrogen fueled rocket engine materials were investigated in high-pressure hydrogen of 19.7 MPa at room temperature. Elongation, reduction of area, and ultimate tensile strength in hydrogen were smaller than those in argon both alloys. The effect of hydrogen on the tensile properties increased with decreasing strain rate. Dimple rupture was mainly observed in argon in both alloys. In hydrogen, fracture was observed along the interface between the delta phase and the gamma matrix for Inconel 718 and that along the interface between the gamma-prime and the gamma matrix for Udimet 720. For Inconel 718, crack initiation occurred at carbide and propagation occurred along the interface between the delta phase and the gamma matrix in hydrogen. For Udimet 720, crack initiation occurred at the precipitate and the crack propagated along the interface between the gamma-prime phase and the gamma matrix in hydrogen.

A91-43281 Interfacial reaction between aluminum borate whisker and AC8A and 6061 aluminum alloys. KATSUAKI SUGANUMA, GENN SASAKI, TERUAKI FUJITA, and NOBUYUKI SUZUKI, *Japan Institute of Light Metals Journal* (ISSN 0451-5994), Vol. 41, May 1991, pp. 297-303. 5 Refs.

The microstructure of the aluminum-borate-whisker-reinforced AC8A-matrix composite fabricated by squeeze casting was examined with a high-resolution electron microscope, to identify interfacial reactions between the whisker and the matrix. Reaction products observed on the whisker surface were identified as MgAl_2O_4 (partly $\gamma\text{-Al}_2\text{O}_3$). The reaction products were found to introduce large strain inside the composite to accommodate the lattice mismatch with a whisker. The reaction products showed the following crystallographic orientation relationships: 010-plane-oriented $\text{Al}_{18}\text{B}_4\text{O}_{33}/111$ -plane-oriented MgAl_2O_4 and 110-line-oriented $\text{Al}_{18}\text{B}_4\text{O}_{33}/110$ -line-oriented MgAl_2O_4 .

A92-13441 Scattering in stress corrosion resistance of RRA-treated 7475 aluminum alloys. TADAKAZU OHNISHI and HIDEKI KUME, *Japan Institute of Light Metals Journal* (ISSN 0451-5994), Vol. 41, Sept. 1991, pp. 582-589. 12 Refs.

The stress corrosion cracking (SCC) resistance properties of conventionally treated and RRA-treated aluminum alloy sheets were examined. It was found that, while the SCC lives of the RRA-treated specimens varied widely, the minimum levels of lives of RRA-treated specimens were close to that of T6 specimens. Additional treatments, such as preaging at low or high temperatures or repetition of retrogression and reaging procedures produced insignificant improvement. On the other hand, considerable improvement of SCC resistance with high statistical reliability was obtained for specimens treated by the RRA condition containing an overaging retrogression process.

A91-49074 Structure of oxide scale of binary Ti-Al alloys formed in high temperature air. YOSHIAKI SHIDA and HIROYUKI ANADA, *Japan Institute of Metals Journal* (ISSN 0021-4876), Vol. 55, June 1991, pp. 690-695. 12 Refs.

Oxide scale structure of binary Ti-Al alloys containing 20 to 63 mass pct Al oxidized in air was studied at 1073 K, 1123 K, and 1173 K. It was observed that, for alloys containing less than 51 percent Al multilayered scale was formed accompanying internal oxidation zone at the base giving smaller oxidation resistance, while for 63 percent Al alloy oxidation resistant external scale was formed. It was discussed that, for the transition from internal to external oxidation in the Ti-Al alloys, very high value of critical internal oxide volume fraction was necessary. Also, the internal oxide morphology appeared to influence the structure of the inner scale layer and then the oxidation rate.

A91-44752 Heterogeneous precipitation of intermediate phases on Al₃Zr particles in Al-Cu-Zr and Al-Li-Cu-Zr alloys. MOTOHIRO KANNO and BIN-LUNG OU, *JIM, Materials Transactions* (ISSN 0916-1821), Vol. 32, May 1991, pp. 445-450. Translation. Research supported by Light Metals Educational Foundation. 13 Refs.

Heterogeneous precipitation of partially coherent precipitates on dispersoid particles of Al₃Zr was examined in both Al-4Cu-0.18Zr and Al-2Li-3Cu-0.15Zr alloys with special attention to the coherency state of the dispersoids which might change during solution-treatment on account of recrystallization. In the Al-Cu-Zr alloy the dispersoids were coherent in recovered (unrecrystallized) regions and they acted as heterogeneous nucleation sites for a theta-prime phase in such a way that the dispersoids were in contact with broad coherent planes of the theta-prime precipitates. On the other hand, the dispersoids became incoherent with matrix in recrystallized regions and they were in contact with narrow incoherent planes of the theta-prime precipitates. In the Al-Cu-Li-Zr alloy, however, the dispersoids were coherent both in recovered and recrystallized regions and they were in contact with coherent planes of T(1) precipitates. The change in nucleation behavior was explained in terms of the reduction in the interfacial energies on nucleation.

A91-42085 Synthesis of amorphous powders of Ni-Si and Co-Si alloys by mechanical alloying. KEISUKE OMURO and HARUMATSU MIURA, *Japanese Journal of Applied Physics, Part 2* (ISSN 0021-4922), Vol. 30, May 1, 1991, pp. L851-L853. 10 Refs.

Amorphous powders of the Ni-Si and Co-Si alloys are synthesized by mechanical alloying (MA) from crystalline elemental powders using a high energy ball mill. The alloying and amorphization process is examined by X-ray diffraction, differential scanning calorimetry (DSC), and scanning electron microscopy. For the Ni-Si alloy, it is confirmed that the crystallization temperature of the MA powder, measured by DSC, is in good agreement with that of the powder sample prepared by mechanical grinding from the cast alloy ingot products of the same composition.

A91-41323 Effect of Fe and Ni additions on the properties of rapidly solidified 2024 and 2219 aluminum alloys. SU-GUN LIM, JUNICHI KANEKO, and MAKOTO SUGAMATA, *Japan Institute of Light Metals Journal* (ISSN 0451-5994), Vol. 41, April 1991, pp. 251-257. 18 Refs.

Cold pressing, vacuum degassing, and hot extrusion were used to consolidate flakes of 2024 and 2219 Al alloys produced via melt atomization and splat-quenching. The hardness of flakes and P/M materials was found to increase with combined additions of Fe and Ni, due to a fine dispersion of the ternary compound FeNiAl₉. While both 2024 and 2219 exhibited age-hardenability decreases with Fe and Ni addition, the decrease was more pronounced in 2219. Tensile strengths were higher for as-extruded than T6-tempered samples; as-extruded samples of both alloys with 4 wt pct Fe and Ni showed tensile strength higher than 550 MPa.

A92-19022 Discontinuous deformation of Al-Mg alloys. KATUO SAITOU, YASUO OTOGURO, and JUNJI KIHARA, *Japan Institute of Metals Journal* (ISSN 0021-4876), Vol. 55, Oct. 1991, pp. 1093-1101. 35 Refs.

The discontinuous deformation of Al-Mg alloys was investigated experimentally in the temperature range 243-473 K as a function of solute concentration (0.2-2.5 percent by mass) and grain size (40-500 microns). A parameter characterizing the relationship between the critical strain and the strain rate is shown to depend both on the solute concentration and grain size and increases with Mg concentration. This effect is discussed assuming that deformation-induced vacancies depend on the plastic strain. Activation energies for discontinuous deformation are determined.

A91-41322 Corrosion behavior and stress corrosion cracking resistance of Al-Li alloys. SHUHEI OHSAKI and TSUNEO TAKAHASHI, *Japan Institute of Light Metals Journal* (ISSN 0451-5994), Vol. 41, April 1991, pp. 225-231. 13 Refs.

Three type Al-Li alloys (8090, 8091 and 2090) sheets were aged at 443 K in various temper conditions, and evaluated for corrosion behavior and resistance to stress corrosion cracking (SCC) initiation in sodium chloride solution. The underaged alloys were susceptible to intersubgranular corrosion, which is apt to lead localized corrosion pits. The peak-aged alloys suffered from dimple type pitting, on alloy 8090 and alloy 8091 preferentially along subgrain and grain boundaries, and on alloy 2090 within grains also. The resistance to SCC initiation was in agreement with that to localized corrosion owing to intersubgranular corrosion, improved with increasing aging time, and ranked in the order of alloy 8090, alloy 2090, and alloy 8091.

A91-37719 Effects of mechanical properties on machinability of various aluminum alloys. HISAKIMI NOTOYA, SHIGERU YAMADA, YUZO TAKATSUJI, ICHIZO TSUKUDA, and HIDEYUKI MIZUTANI, *Japan Institute of Light Metals Journal* (ISSN 0451-5994), Vol. 41, March 1991, pp. 178-183. 18 Refs.

Various aluminum alloys (2011-T8, 3003-H14, 4032-T6, 5056-H14, G67-T6, 7075-T6 and Al-17 pct Si-T6) were turned with K10 and diamond compact tools to examine the cutting behavior under wide range of cutting conditions. The effects of mechanical properties (hardness, tensile strength shear stress of high temperature and coefficient of friction for K10 tool against work materials) of these alloys on cutting forces, chip forms and finished surface roughness were discussed. Chip forms and cutting forces depended on the coefficient of friction on the rake face of K10 tool at high temperature. Cutting forces and chip forms cut with diamond compact tool differed from those with K10 tool.

A91-33503 Controlling factors of the ductility in Al-Mg alloys. MASAHIRO YANAGAWA and SHOJIRO OIE, *Japan Institute of Light Metals Journal* (ISSN 0451-5994), Vol. 41, Feb. 1991, pp. 119-125. 12 Refs.

Influence of Mg content, grain size, 0.2-percent proof stress, and alloying elements (such as Zn, Mn, Cu, or Y) on the ductility of Al-Mg alloys have been investigated, and controlling factors have been revealed. The uniform elongation is expressed by $\epsilon(u) = n(1 - \sigma_0/\sigma_i)$ where n is the strain hardening exponent, σ_i the true ultimate tensile strength, σ_0 , the 0.2-percent proof stress, and $\epsilon(u)$, the uniform elongation. The strain hardening exponent n increases as the Mg content increases, which depends on the increasing difficulties of the cross slip of dislocations. The 0.2-percent proof stress σ_0 decreases as the grain size increases, which increases the uniform elongation $\epsilon(u)$.

A91-32673 Wear resistance of Al-Si alloys and aluminium matrix composites. THAN TRONG LONG, TAKANOBU NISHIMURA, TATSUYOSHI AISAKA, and MIKIO MORITA, *JIM, Materials Transactions* (ISSN 0916-1821), Vol. 32, Feb. 1991, pp. 181-188. 12 Refs.

The wear resistance for hypereutectic Al-Si alloys and Al-Si, 6061, 4032 alloys reinforced with Al₂O₃ fibers, SiC particulates, SiC whiskers, C fibers, and Pb particulates has been investigated. The wear loss for hypereutectic Al-Si alloy is observed to be inversely proportional to the size and directly proportional to the spacing of Si particles and the counter material surface roughness. The effect of SiC whisker on wear resistance for Al-Si alloys is described. The composites reinforced with a hybrid of SiC whisker, SiC particulate, and C fiber exhibit excellent wear resistance. SiC whisker is found to be a barrier against slip of relatively large reinforcements.

A91-31187 The boron effect on the superplastic deformation of Ni₃(Si,Ti) alloys. T. TAKASUGI, S. RIKUKAWA, and S. HANDA, *Scripta Metallurgica et Materialia* (ISSN 0956-716X), Vol. 25, April 1991, pp. 889-894. 11 Refs.

The effect of boron on the superplastic behavior of Ni₃(Si,Ti) alloys was investigated experimentally using specimens with partially recrystallized and fully recrystallized fine-grained structures. Both boron-doped and boron-free Ni₃(Si,Ti) alloys with an L1(2) structure exhibited superplasticity in both fully recrystallized fine-grained and partially recrystallized structures. Maximum tensile elongations were observed at temperatures between 1123 and 1148 K for an initial strain rate of 0.00006/s. The results clearly indicate that boron doping reduces the high-temperature elongation and is therefore detrimental from the standpoint of superplastic deformation.

A91-28246 Crystal structure of '4H' martensite observed in Ti-Ni-Cu shape memory alloys. TSUGIO TADAKI, KEN'ICHI SHIMIZU, and C. M. WAYMAN, *JIM, Materials Transactions* (ISSN 0916-1821), Vol. 32, Jan. 1991, pp. 43-47. Research supported by Osaka University and MOESC. 20 Refs.

The crystal structure of a martensite with a 4H-like structure, which was reported so far to exist not only in binary Ti-Ni but also in ternary Ti-Ni-Cu alloys in addition to the major martensite with a B19-prime structure, has been examined by electron diffraction. The '4H' martensite was found to possess a monoclinic structure with $a = 0.491$, $b = 0.720$, $c = 0.931$ nm and $\gamma = 93.3$ deg, in which complicated atomic shuffles were expected to occur three-dimensionally. The crystal structure is thus not a simple 4H long period stacking order structure.