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Russian and Japanese Aerospace Literature

During 1994 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 Titanium Alloys 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 N00014-93-I-1074.

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Russian Aerospace Literature This month: *Titanium Alloys*

A93-54955 Deformation characteristics of an amorphous titanium alloy under conditions of repeated loading (Osobennosti deformatsii amorfnogo titanovogo splava v usloviyakh posledovatel'nogo nagruzheniya). A. V. MINEEV, P. B. BUDBERG, and S. P. ALISOVA, RAN, Inst. Metallurgii, Moscow, Russia. *Fizika i Khimiya Obrabotki Materialov* (ISSN 0015-3214), No. 4, July–Aug. 1993, pp. 142–146. Documents Available from Aeroplus Dispatch.

Creep characteristics of an amorphous titanium-based alloy (58Ti-33.3Cu-7.0Ni- 1.7Si, in at. pct) were measured at room temperature and sigma (b) values 0.5 to 0.7. Measurements of residual deformation after repeated steps of loading and unloading showed a lesser deformation after loading at 0.7 sigma (b) than at the earlier loading/unloading steps, with negative deformation reaching 0.1 percent. It is suggested that the procedure of repeated loading and unloading has an effect of 'training' for the amorphous alloy, and significantly (up to a factor of 1.5) increases its strength.

A93-53581 Interaction of twins with dislocations and twins in TiAl. II—Interaction between twins (Vzaimodejstvie dvojnikov s dislokatsiyami i dvojnikami v TiAl. II—Vzaimodejstvie dvojnikov). L. E. KAR'KINA and M. V. PONOMAREV, RAN, Inst. Fiziki Metallov, Yekaterinburg, Russia. *Fizika Metallov i Metallovedenie* (ISSN 0015-3230), Vol. 75, No. 3, March 1993, pp. 155–161. Documents Available from Aeroplus Dispatch.

The intersections between two twins in a polycrystalline TiAl alloy deformed by 0.2 to 1 percent at temperatures 20, 300, 400, and 600 C were investigated by means of TEM observations. New mechanisms of twin generation at the intersection between twins are identified.

A93-53580 Interaction of twins with dislocations and twins in TiAl. I—Interaction with dislocations (Vzaimodejstvie dvojnikov s dislokatsiyami i dvojnikami v TiAl. I—Vzaimodejstvie s dislokatsiyami). L. E. KAR'KINA and A. B. NOTKIN, RAN, Inst. Fiziki Metallov, Yekaterinburg; Rossijskij Inst. Legkikh Splavov, Moscow, Russia. *Fizika Metallov i Metallovedenie* (ISSN 0015-3230), Vol. 75, No. 3, March 1993, pp. 147–154. Documents Available from Aeroplus Dispatch.

The nature of interactions of different types of dislocations with twins in a Ti-50Al (at. pct) alloy specimens deformed by 0.1 to 1 percent by compression at temperatures 20, 300, 400, and 600 C was investigated using TEM observations. Results showed that the matrix-twin interface is 'transparent' for single dislocations and superdislocations with the Burgers vector parallel to the twin plane. In other cases, dislocations are pinned at the interface and react with the twinning dislocations, inhibiting the dislocation motion and twin growth.

A93-53578 The relation between mechanical properties and quantitative microstructural characteristics in VT3-1 and VT-23 alloys (Vzaimosvyaz' mekhanicheskikh svojstv s kolichestvennymi kharakteristikami mikrostruktury dlya splavov VT3-1 i VT-23). V. I. POLYANSKIJ, O. I. PIROG, and M. I. SILIS, NPO Kompozit, Kaliningrad, Russia). *Fizika Metallov i Metallovedenie* (ISSN 0015-3230), Vol. 75, No. 4, April 1993, pp. 176–181. Documents Available from Aeroplus Dispatch.

The relation between the mechanical properties of VT3-1 (T-6Al-2Cr-0.5Fe- 0.3Si, in wt pct) and VT-23 (Ti-5.5Al-2Mo-1.5V-1Cr-0.7Fe) alloys and their microstructure after heat treatment was investigated using results of measurements of strength characteristics and of microscopic examinations. It was found for both alloys that there exists a relationship between the ultimate strength and the relative reduction in the cross-sectional area. A correlation is also observed between the content of alpha phase, the distance between alpha- phase particles, and their form factor.

A93-53577 Characteristics of the plastic deformation of Ti3Al single crystals (Osobennosti plasticheskoj deformatsii monokristallov Ti3Al). E. V. PANOVA, L. E. KAR'KINA, E. P. ROMANOV, RAN, Inst. Fiziki Metallov, Yekaterinburg, Russia). *Fizika Metallov i Metallovedenie* (ISSN 0015-3230), Vol. 75, No. 4, April 1993, pp. 166–175. Documents Available from Aeroplus Dispatch.

The characteristics of the dislocation structure in Ti3Al single crystals subjected to mechanical deformation at room temperature, 400 C, and 600 C were investigated using Ti3Al single crystals grown by zone melting and heat treated at 1050 C, which contained alpha-2 phase. Results of X-ray analyses showed the existence of a positive relation between the yield strength and temperature, with a maximum yield strength observed at about 840 C. The yield strength peak was found to be related to the effect of a slip system. The dislocation structure is characterized by the presence of previously unknown configurations consisting of blocked spiral superdislocations.

A93-53499 Friction surfacing and linear friction welding. E. D. NICHOLAS, TWI, Forge and Resistance Processes Dept., Cambridge, United Kingdom. *International SAMPE Technical Conference, 24th and International SAMPE Metals and Metals Processing Conference, 3rd*, Toronto, Canada, Oct. 20–22, 1992, *Proceedings*. Vol. 3 (A93-53376 23-23). Covina, CA, Society for the Advancement of Material and Process Engineering, 1992, pp. M450–M463. Documents Available from Aeroplus Dispatch.

The paper describes the development of the friction-surfacing and linear-friction welding technologies, with particular attention given to the equipment evolution and the application of the processes and advanced materials (such as intermetallics, metal-matrix composites (MMCs), ODS alloys, and powder metallurgy alloys) for the aerospace industry. The use of friction surfacing to modify the surface material with MMCs, to repair defects by plugging, and manufacture/reprocess materials is described. Documents Available from Aeroplus Dispatch.

A93-53323 Parameters of the crystalline structure and the sequence of transformations in ternary TiNi-TiMe alloys (Parametry kristallicheskoj struktury i posledovatel'nost' prevrashchenij v trojnykh splavakh TiNi-TiMe). N. M. MATVEEVA, A. A. KLOPOTOV, N. M. KORMIN and YU. A. SAZANOV, *Metally* (ISSN 0869-5733), No. 3, May–June 1993, pp. 232–236. Documents Available from Aeroplus Dispatch.

The effect of electronic factor changes in pseudobinary TiNi-TiMe alloys (where Me is Pd, Pt, Fe, Au, Cu, or Rh), due to the introduction of a third metal component, on the structure and stability of the system was investigated. It was found that the dependence of the superlattice compression on the electron concentration in TiNi-TiMe alloys correlates with the sequence of martensitic transformations in these alloys.

A93-52952 Optimized selection of the surface treatment and spraying (Optimizatsionnyj vybor poverkhnostnoj obrabotki i napyleniya). S. M. BOROVSKI,J *Aviatsionnaya Tekhnika* (ISSN 0579-2975), No. 1, 1993, pp. 62–67. Documents Available from Aeroplus Dispatch.

It is demonstrated that preparatory work can be done in order to optimize the choice of an optimal (with respect to mechanical strength) version of the surface treatment and spraying process. The preparatory work involves nondestructive physicochemical and mechanical evaluations of the surface adsorption and wetting characteristics and of the elastic loading of the surface. Optimization of surface treatments for VT9 titanium alloy and 30KhGSNA martensitic steel is discussed as an example.

N94-10026 A manufacturing technique for lightweight structures. G. DORNIER BRODEN, Luftfahrt G.m.b.H., Friedrichshafen, Germany. In ESA, *Advanced Materials for Lightweight Structures*, pp. 149–153 (SEE N94-10001 01-24).

The principles of SPF/DB (Super Plastic Forming/Diffusion Bonding) facilities and the SPF/DB process are presented. Recently developed SPF/DB structures, five wall components and a precooler exhaust, made from Ti6Al4V intended for serial production are presented. The advanced structural concept for a leading edge manufactured with a modified four sheet technology is addressed. For aluminum structures the process is restricted to pure superplastic forming up to now because of the difficult joining technique for aluminum alloys. Large high strength aluminum structures formed with the membrane technique are presented. The use of membrane technique in comparison to conventional SPF technique is discussed. An overview of the work on developing a joining technique for aluminum and aluminum-lithium alloys compatible with the SPF process is given with results of fundamental work on diffusion bonding. Some results from the determination of SPF properties and from DB process parameter evaluation are presented. (ESA).

N94-10004 Spinforming characteristics of a net shape forming process. D. MUELLER-WIESNER, Erno Raumfahrttechnik G.m.b.H., Bremen, Germany, E. SIEGER, Zeppelin-Metallwerke G.m.b.H., Friedrichshafen, Germany, and Messerschmitt-Boelkow-Blohm G.m.b.H., Bremen (Germany). In *ESA, Advanced Materials for Lightweight Structures*, pp. 15–18 (SEE N94-10001 01-24).

The characteristics of the (near) net shape spin forming process are discussed. In addition to the description of process parameters and the machining, interdependencies between the process and properties of materials are indicated. Examples of the application of the spin forming process to hemispheres and domes for spacecraft propellant tasks, fabricated out of aluminum and steel alloys, are given. Aspects of future developments with respect to titanium beta and aluminum lithium alloys are addressed. (ESA).

A93-46971 Formation of basal texture in the BT23 alloy by means of cross rolling (Formirovanie bazisnoj tekstury v splave VT23 putem poperechnoj prokatki). I. V. EHGIZ, A. A. BABAREHKO, A. I. KHOREV, M. M. MARTYNOVA, and T. M. IVANOVA, *Metally* (ISSN 0568-5303), No. 6, Nov.–Dec. 1992, pp. 99–104. Documents Available from Aeroplus Dispatch.

Rolling conditions are investigated for obtaining a sufficient fraction of basal structure in BT23 sheet over its full thickness. Six regimes of plastic deformation (lengthwise rolling followed by cross rolling at different temperatures) of the BT23 are tested, with the resultant metal plate structure identified by an X-ray method. It is found that the greatest basal structure fraction is obtained after direct rolling at a temperature leading to the formation of a 1 1–2 0-line prismatic structure in the direction normal to the sheet plane, followed by cross rolling leading to intensive primary twinning with no secondary twinning.

A93-46970 Effect of deformation temperature on the mechanical properties and microstructure of Ti3Al intermetallic (Vliyanie temperatury deformatsii na mekhanicheskie svoistva i mikrostrukturu intermetallida Ti3Al). R. M. IMAEV, N. K. GABDULLIN, and G. A. SALISHCHEV, *Metally* (ISSN 0568-5303), No. 6, Nov.–Dec. 1992, pp. 73–79. Documents Available from Aeroplus Dispatch.

The effect of hot compressive deformation on the microstructure of a stoichiometric Ti3Al alloy was investigated. Results indicate that, at temperatures between 700 and 1100 C, Ti3Al undergoes dynamic recrystallization, leading to a significant refinement of the alloy microstructure. Results of tension tests on fine-grained Ti3Al showed that, at 1000 C and a deformation rate of $5 \times 10 \exp -4$/sec, the alloy exhibits signs of superplasticity. The refinement of the alloy microstructure leads to an increase of its plasticity in the brittle-ductile transition interval.

A93-45612 X-phase precipitation and structural recovery in TiNi-based three-component alloys (Vydelenie X-fazy i strukturnyj vozvrat v trekhkomponentnykh splavakh na osnove nikelida titana). A. G. KHUNDZHUA and A. V. SOROKIN, Moskovskij Gosudarstvennyj Univ., Moscow, Russia. *Rossijskaya Akademiya Nauk*, Izvestiya, Seriya Fizicheskaya (ISSN 0367-6765), Vol. 57, No. 2, Feb. 1993, pp. 117–119. (Vsesoyuznyj Simpozium po Metodam Difraktsii Ehlektronov v Issledovanii Struktury Veshchestva, 1st, Zvenigorod, Russia, Nov. 3–6, 1991). Documents Available from Aeroplus Dispatch.

Results of an electron diffraction microscopy study of the fine crystal structure of bcc solid solutions based on TiNi are presented. The structural transformations taking place in Ni50Ti46Me4 (Me = V, Nb, Ta, Cr, Mo, Mn, and Re) during isothermal annealing at 350 C are examined. In all the alloys investigated, intense diffusion scattering effects corresponding the early stages of X-phase precipitation are observed in the heat treated condition.

A93-43127 Phase composition and texture of a titanium alloy following a thermomechanical treatment (Fazovyj sostav i tekstura titanovogo splava posle termomekhanicheskoj obrabotki). E. B. EGOROV, S. YA. BETSOFEN, and V. N. MESHCHERYAKOV, RAN, Inst. Metallurgii, Moscow, Russia. *Fizika i Khimiya Obrabotki Materialov* (ISSN 0015-3214), No. 2, Mar.–Apr. 1993, pp. 130–134. Documents Available from Aeroplus Dispatch.

The control of the variables of the thermomechanical treatment (temperature and deformation rate) of titanium alloys for achieving superplasticity is discussed. It is shown that the texture of titanium alloys is highly sensitive to the deformation temperature. The potential of the texture analysis of two-phase titanium alloys as a method of controlling the superplastic deformation temperature is examined.

A93-43023 Structural inhomogeneities and magnetic anisotropy of amorphous Co-Ti films (Strukturnye neodnorodnosti i magnitnaya anizotropiya amorfnykh plenok Co-Ti). YU. D. VOROB'EV, I. M. SLABZHENNIKOVA, L. A. CHEBOTKEVICH, E. V. PUSTOVALOV, and M. V. GOLOVKO, Dal'nevostochnyj Gosudarstvennyj Univ., Vladivostok, Russia). *Fizika Metallov i Metallovedenie* (ISSN 0015-3230), Vol. 75, No. 1, Jan. 1993, pp. 59–63. Documents Available from Aeroplus Dispatch.

By using high-resolution electron microscopy, three types of structural inhomogeneities have been identified in amorphous Co-Ti films: clusters, chains of clusters, and areas of low-density material, with characteristic sizes of 1.2–1.5, 4.8–5.0, and 12 nm, respectively. The relationship between magnetic anisotropy and the type and distribution of structural inhomogeneities is examined. The components of magnetic anisotropy associated with structural inhomogeneities are estimated. It is shown that the rotation of the axis of light magnetization in an external field depends on the type of structural inhomogeneity.

A93-36717 Characteristics of the formation of the cast structure of supercooled Al-Ti alloys (Zakonomernosti formirovaniia litoi struktury pereokhlazhdennykh Al-Ti splavov). I. G. BRODOVA, I. V. POLENTS, V. O. ESIN, and E. M. LOBOV, RAN, Inst. Fiziki Metallov, Yekaterinburg, Russia. *Fizika Metallov i Metallovedenie* (ISSN 0015-3230), No. 1, Jan. 1992, pp. 84–89. In Russian. Documents Available from Aeroplus Dispatch.

The dimensions and growth morphology of primary phase crystals and alpha solid solution grains in Al-4.55 pcr Ti and Al-6 pct Ti alloys are investigated as a function of the solidification conditions (melt heating temperature and cooling rate). Conditions are determined for the formation of a metastable phase, Al3Ti, with a cubic L1(2) lattice and for the formation of a supersaturated solid solution as a result of the suppression of the primary crystallization of intermetallics.

A93-36715 Stability of an ordered orthorhombic alpha (0) phase in Ti60Nb8Al alloy (O stabil'nosti uporiadochennoi ortorombicheskoi alpha/0/-fazy v splave Ti60Nb8Al). T. L. TRENOGINA, V. A. VOZILKIN, and S. B. VOLKOVA, RAN, Inst. Fiziki Metallov, Yekaterinburg, Russia. *Fizika Metallov i Metallovedenie* (ISSN 0015-3230), No. 12, Dec. 1992, pp. 96–98. In Russian. Documents Available from Aeroplus Dispatch.

The structural changes occurring in Ti60Nb8Al alloy following a stepped heat treatment are investigated experimentally using X-ray diffraction analysis and electron microscopy. It is found that the ordered orthorhombic alpha (0) phase precipitating in the alloy is an intermediate metastable phase. The orthorhombic alpha (0) phase dissolves partially during the subsequent low-temperature annealing.

A93-32152 Effect of aluminum on the structure and properties of a Ti-60 pct Nb alloy (Vliianie aliuminila na strukturu i svoistva splava Ti-60 pct Nb). V. A. VOZILKIN, T. L. TRENOGINA, and S. B. VOLKOVA, RAN, Inst. Fiziki Metallov, Yekaterinburg, Russia. *Fizika Metallov i Metallovedenie* (ISSN 0015-3230), No. 11, Nov. 1992, pp. 108–113. In Russian. Documents Available from Aeroplus Dispatch.

The structure and phase composition of a Ti-60 pct Nb alloy containing aluminum are investigated by transmission electron microscopy and X-ray diffraction analysis following hardening and tempering at 400–900 C. It is shown that alloying with 1–3 percent Al leads to the decomposition of the stabilized bcc beta solid solution and precipitation of hexagonal alpha-phase particles. In a Ti-60 pct Nb-8 pct Al alloy hardened from 1150 C, matrix ordering with the formation of a B2 structure is observed. In an alloy with 5 pct Al, such ordering occurs only during a subsequent anneal at 500 C. In both ordering alloys, a structure consisting of an orthorhombic phase precipitated from the B2 matrix is predominant at 600–900 C.

A93-32150 Formation of the omega phase under pressure in a titanium-1 at pct vanadium alloy (Obrazovanie omega-fazy pod davleniem v splave titan-1 at.pct vanadiia). A. V. DOBROMYSLOV, G. V. DOLGIKH, K. M. DEMCHUK, and A. N. MARTEM'IANOV, RAN, Inst. Fiziki Metallov, Yekaterinburg, Russia. *Fizika Metallov i Metallovedenie* (ISSN 0015-3230), No. 10, Oct. 1992, pp. 130–138. In Russian. Documents Available from Aeroplus Dispatch.

The structure of a Ti-1 at. pct V alloy was investigated by X-ray diffraction analysis, optical metallography, and transmission electron microscopy following loading by quasi-hydrostatic pressure at 8 GPa. It is shown that the omega phase, formed in the alloy under hydrostatic pressure, is retained after the pressure is relieved. The omega phase is formed in big massive colonies and partially inherits the morphology of the original alpha prime phase. An analysis of diffuse scattering indicates the presence of linear defects in the structure of the omega phase.

A93-32147 Structure and high-temperature properties of high-nickel Kh12N30M3 alloy with titanium (Struktura i zharoprochnye svoistva vysokonikelevogo splava X12H30M3, legirovannogo titanom). V. M. ALIAB'EV, T. N. KOCHETKOVA, S. S. LAPIN, and V. V. SAGARADZE, RAN, Inst. Fiziki Metallov, Yekateriburg, Russia. *Fizika Metallov i Metallovedenie* (ISSN 0015-3230), No. 9, Sept. 1992, pp. 146–154. In Russian. Documents Available from Aeroplus Dispatch.

Results of an experimental study of the structure and high-temperature properties of a titanium-alloyed high-nickel system, Kh12N30, are reported. The creep behavior of the alloy is explained in terms of aging processes with precipitation of an ordered gamma prime phase, Ni3Ti. The optimal titanium concentrations, which allow the precipitation hardening of the alloy with the retention of a sufficiently high level of ductility, are determined.

A93-32146 Texture contribution to the anisotropy of the elastic properties of a rolled two-phase Ti-6Al-4V alloy (Teksturnyi vklad v anizotropiiu uprugikh svoistv prokatannogo dvukhfaznogo splava Ti-6Al-4V). S. V. DIVINSKII, V. N. DNEPRENKO, and O. M. IVASISHIN, ANU, Inst. Metallofiziki, Kiev, Ukraine. *Fizika Metallov i Metallovedenie* (ISSN 0015-3230), No. 9, Sept. 1992, pp. 73–81. In Russian. Documents Available from Aeroplus Dispatch.

A method is proposed for calculating the texture contribution to the anisotropy of the elastic properties of hcp polycrystals. The method is based on previously developed concepts related to the modeling of the polar figures of metal rolling textures with superposition of limited axial components. The averaged elastic constants and Young modulus for rolled sheets of Ti-6Al-4V alloy are calculated in the two-phase (alpha+beta) region. The texture contribution to the Young modulus is determined for a specimen as a whole and for each individual phase.

N93-22592 Continuous production of granular or powder Ti, Zr, and Hf or their alloy products Patent Application. JACK C. WHITE, ODEN, and L. LAURANCE, inventor (to Interior Dept.)s.(Author)

The invention relates to continuous production of granular titanium, zirconium or hafnium metal or their alloys by: dissolving reducing metals such as sodium, magnesium or lithium in their respective halide salts to produce a reducing molten salt process stream; preparing a second molten salt stream bearing Ti, Zr, or Hf in solution; mixing and reacting the two molten salt process streams in a continuous stirred tank reactor where control of the concentrations of reactants, the contacting pattern, and the temperature produce orderly growth of granular metal free of halide inclusions; removing granular metal from the system; and leaching the remaining salts from the granular metal.

A93-23129 Effect of some loading conditions on the fracture toughness of metal materials (Vliianie nekotorykh uslovii nagruzheniia na treshchinostoikost' metallicheskikh materialov). B. A. DROZDOVSKII, I. P. ZHEGINA, N. I. NOVOSIL'TSEVA, and A. V. PROKHODTSEVA, VIAM, Moscow, Russia. *Fiziko-Khimicheskaia Mekhanika Materialov* (ISSN 0430-6252), Vol. 28, No. 1, Jan.–Feb. 1992, pp. 37–44. In Russian.

Smooth and cracked specimens of Al-Cu and Al-Mg-Li alloys, high-strength steels, and alpha+beta and pseudo-beta titanium alloys were tested in tension and three-point bending at varying strain rates in the temperature range from 20 to −196 C. It is found that an increase in the strain rate significantly increases the fracture toughness of 1201 alloy, 35KhSN3MA, and VT23 titanium alloy over the entire strain rate investigated, whereas no change is observed in the case of the Al-Mg-Li alloy and VKS-210 steel. An analysis of the results obtained indicates that in the case of high-strength steels, and aluminum and titanium alloys, there is no direct relation between the increasing strain rate and cold brittleness that is characteristic of low-carbon low-alloy steels.

A93-27672 Isothermal sections of the system Nb-Ti-Al at 900 and 600 C (Izotermicheskie secheniia sistemy Nb-Ti-Al pri 900 i 600 C). A. V. PAVLOV, A. M. ZAKHAROV, G. V. KARSANOV, and L. L. VERGASOVA, *Metally* (ISSN 0568-5303), No. 5, Sept.–Oct. 1992, pp. 117–119. In Russian.

The phase composition of Nb-Ti-Al alloys containing 0–40 pct Ti and 0–40 pct Al was investigated at 900 and 600 C using metallographic, X-ray diffraction, and electron probe analyses. Depending on the alloy composition and temperature, intermediate phases, including cubic beta prime (Nb3Al), tetragonal sigma (Nb, Ti)2Al), z(NbAl3), and gamma (TiAl), and ordered rhombic alpha*2 (Ti12Nb3Al5 or Ti2NbAl) phases are found to exist in the alloys in addition to the niobium-based bcc beta solid solution. The formation temperature of the alpha*2 phase is estimated at 1000–1050 C.

A93-27671 Phase equilibriums in the system Nb-Ti-Al in the concentration range 25–40 percent Ti and 0–20 percent Al (Fazovye ravnovesiia v sisteme Nb-Ti-Al v intervale kontsentratsii 25–40 pct Ti i 0–20 pct Al). A. M. ZAKHAROV, S. V. OLEINIKOVA, and T. R. SMIRNOVA, *Metally* (ISSN 0568-5303), No. 5, Sept.–Oct. 1992, pp. 112–116. In Russian.

The isothermal sections of the system Nb-Ti-Al are constructed in the concentration range 25–40 percent Ti and 0–20 percent Al at 1100 and 900 C using metallographic, X-ray diffraction, and electron probe analyses. Depending on the chemical compositions of the alloys studied and temperature, the following phases are identified: a bcc beta solid solution, an alpha*2 rhombic phase of Ti(2.4)Nb(0.6)Al or Ti2NbAl composition, and tetragonal phases sigma (Nb2Al) and gamma (TiAl). The solubility of niobium in the gamma phase reaches 42 percent.

A93-27651 Effect of the intragranular structure on the fracture characteristics and the properties of coarse-grained VT23 alloy in the heat treated condition (Vliianie vnutrirezervnogo stroeniia na kharakter razrusheniia i svoistva krupnozernistogo splava VT23 v termouprochnennom sostoianii). R. G. KOKNAEV, N. A. MARKACHEV, T. I. MALINKINA, G. IA. GORIUNOVA, and O. S. TABUNOVA, NPO VILS, Moscow, Russia. *Fizika Metallov i Metallovedenie* (ISSN 0015-3230), No. 7, July 1992, pp. 93–98. In Russian.

Data on the effect of the intragranular structure on the fracture behavior and the mechanical properties of coarse-grained (700–800 microns) VT23 alloy in the heat treated condition are obtained experimentally using X-ray diffraction and metallographic analyses. It is found that the fracture mechanisms and the level of ductility are largely determined by the amount of primary alpha phase, alpha particle thickness, and the ratio of the interparticle distance to the alpha particle thickness.

A93-27650 Phase formation in titanium alloys during quenching from the molten state (Fazoobrazovanie v splavakh titana pri ikh zakalke iz zhidkogo sostoianiia). S. IA. GOLUB, A. V. KOTKO, N. N. KUZ'MENKO, L. D. KULAK, S. A. FIRSTOV, and B. V. KHAENKO, ANU, Inst. Problem Materialovedeniia, Kiev, Ukraine. *Fizika Metallov i Metallovedenie* (ISSN 0015-3230), No. 6, June 1992, pp. 94–102. In Russian.

The structural state of titanium alloys during melt spinning was investigated by X-ray electron diffraction analysis and optical and electron microscopy. The processes of phase formation under rapid cooling are analyzed; the phase morphology and mutual orientation of their lattices are investigated, and the texture characteristics determined. It is shown that, during melt spinning at cooling rates of $10 \exp 5$–$10 \exp 6$ K/s, the growth of columnar arms of degenerate dendrites is accompanied by the diffusive displacement of Si atoms over distances of the order of 0.1 micron. The structure and some properties of compact samples are examined.

A93-27282 The wettability and the reaction for SiC particle/Al alloy system. M. KOBASHI and T. CHOH, Nagoya Univ., Japan. *Journal of Materials Science* (ISSN 0022-2461), Vol. 28, No. 3, Feb. 1, 1993, pp. 684–690. (Author)

The incorporation process and the wettability for an SiC particles/aluminum alloy system were measured. The wettability between SiC particle and liquid aluminum was evaluated by the time required for the particulate incorporation. The incorporation time could be measured from a stirring time-melt temperature chart. Magnesium and titanium shortened the incorporation time of alpha-SiC particles into liquid aluminum and improved the wettability because of their strong affinity for SiC. Copper and zinc prolonged the incorporation time and no reaction products were found in the matrix. Furthermore, surface active elements with weak affinity for SiC (lead and bismuth) extremely prolonged the incorporation time because these elements prevent the reaction at the interface, whereas lithium shortened the incorporation time remarkably.

A93-26864 Mechanical behavior of submicrocrystalline TiAl intermetallic at elevated temperatures (Mekhanicheskoe povedenie submikrokristallicheskogo intermetallida TiAl pri povyshennykh temperaturakh. R. M. IMAEV, and V. M. IMAEV, RAN, Inst. Problem Sverkhplastichnosti Metallov, Ufa, Russia. *Fizika Metallov i Metallovedenie* (ISSN 0015-3230), No. 2, Feb. 1992, pp. 125–129. In Russian.

The tensile properties of submicrocrystalline TiAl (d = 0.4 micron) were investigated in the temperature range 600–900 C. It is shown that the presence of such a microstructure allows the superplasticity effect to be realized at 800 C at a strain rate of $8.3 \times 10 \exp -4$/s. The relative elongation in this case reaches 225 percent. The relationship between deformation mechanisms and the mechanical behavior of the intermetallic is demonstrated.

A93-26825 Phase diagram of Ti-Cu-Ni (Diagramma sostoianiia Ti-Cu-Ni). S. P. ALISOVA, and P. B. BUDBERG, *Metally* (ISSN 0568-5303), No. 4, July–Aug. 1992, pp. 218–223. In Russian.

The phase diagram of the system Ti-Cu-Ni is obtained using physicochemical analysis techniques and the method of triangulation. The diagram is represented by the liquidus surface, an isothermal section at 600 C, and a scheme of monovariant and nonvariant transformations realized in the alloys of the system over the entire range of concentrations and melting temperatures down to room temperature.

A93-26824 Orientation dependence of the mechanical properties of some Ti-Al-V alloys (Orientatsionnaia zavisimost' mekhanicheskikh svoistv nekotorykh splavov Ti-Al-V). A. R. GOKHMAN and IU. G. MIKHAILIVSKII, *Metally* (ISSN 0568-5303), No. 4, July–Aug. 1992, pp. 158–164. In Russian.

The orientation dependence of the ultimate tensile strength, yield strength, ductility, and percent elongation and reduction of Ti-Al-V alloys is investigated experimentally. The textural strengthening coefficient and strength criteria are determined for sheets of PT-3Vkt and Ti-3 pct Al-1.5 pct V alloys after transverse warm rolling with vacuum annealing followed by cold rolling. The orientation dependence of the mechanical properties of the alloys studied is described by the Ashkenazi criterion.