density and borides on plastic deformation are analysed. B is shown to have a positive effect in increasing density and a negative effect in reducing strength and ductility. 0.2%B gives a density increase and the negative effect is reduced because of the small amount of B and the discontinuous morphology. A pore free surface is shown to improve corrosion properties.

SYNTHESIS AND CONSOLIDATION OF MECHANICALLY ALLOYED IRON-CHROMIUM POWDERS

K.Kobayashi *et al.* (National Industrial Research Inst., Nagoya, Japan.) *J. Jpn Soc. Powder Powder Metall.*, Vol 44, No 6, 1997, 560-564. (In Japanese.)

A range of Fe-Cr powders were mechanically alloyed in Ar. The effect of milling time on synthesis of a non-stoichiometric FeCr phase was investigated. Increase in %Cr increased the time required for homogenization. Powders were consolidated by spark plasma sintering. Fe-48at%Cr sintered to 7.46 $g.cm^{-3}$ without formation of σ phase.

VACUUM SINTERING OF ATOMIZED HYPO-EUTECTIC CAST IRON POWDER

H.Tomino *et al.* (Kagawa Industrial Technology Centre, Takamatsu, Japan.) *J. Jpn Soc. Powder Powder Metall.*, Vol 44, No 6, 1997,590-595. (In Japanese.)

Studies of vacuum sintering of atomized cast iron powder are described. It is reported that sintering at 1090 to 1110°C was rapid, irrespective of %C. Greater density was attained at 3.96wt%C than at 2.46%C. As sintering temperature was increased structures changed in the following sequence, α-Fe_3C, α-pearlite-Fe_3C and pearlite-Fe_3C. Graphite was not detected.

Molybdenum

MOLYBDENUM ALLOYS FOR GLASS-TO-METAL SEALS

G.Thurner *et al.* (Plansee AG, Reutte, Austria.) *Int. J. Refractory Metals Hard Mater.*, Vol 16, No 1, 1998, 13-22.

Glass-to-metal-seals are reviewed with reference to the use of Mo and Mo alloys in this application. Two types of seal are identified, hard glass sealing (thermal expansion matched seals) and quartz glass sealing (ductile metal seals). Types of Mo alloy used are described with regard to oxide additions. Examples given include Mo-La_2O_3, for hard glass seals and elliptically shaped Mo ribbon (ESS Mo) for ductile metal seals. Factors required in the two types are discussed, in particular, composition, wettability, coefficient of thermal expansion, mechanical properties and recrystallization characteristics.

Nickel

HIGH TEMPERATURE SYNTHESIS OF NICKEL-TITANIUM UNDER MICROGRAVITY

Y.Suzuki *et al.* (Hokkaido National Industrial Research Inst., Sapporo, Japan.) *J. Jpn Soc. Powder Powder Metall.*, Vol 44, No 6, 1997, 523-529. (In Japanese.)

Ni-Ti alloy compacts were sintered under microgravity conditions in order to study the reaction between Ni and Ti. Samples were heated and cooled rapidly. The NiTi intermetallic compound was formed by the exothermic reaction. The shape memory alloy was porous.

Titanium

CONSOLIDATION OF MECHANICALLY REACTED TITANIUM NITRIDE BY PLASMA ACTIVATED SINTERING

M.S.El-Eskandarny *et al.* (Tohoku University, Sendai, Japan.) *J. Jpn Soc. Powder Powder Metall.*, Vol 44, No 6, 1997, 547-553. (In English.)

Ti-44at%N powder was synthesized by milling Ti powder in a N flow. The milling process, particle agglomeration, agglomerate fracture and TiN synthesis is described. The milled powder consists of Ti and TiN. Powders milled for various times were consolidated by plasma activated sintering. Consolidated materials retained a nano-crystalline structure with a grain size of about 65 nm. Hardness and some mechanical properties were measured as a function of milling time.

CONSOLIDATION OF TITANIUM TRI-ALUMINIDE BY SPARK PLASMA SINTERING

K.Kobayashi *et al.* (National Industrial Research Inst., Nagoya, Japan.) *J. Jpn Soc. Powder Powder Metall.*, Vol 44, No 6, 1997, 554-559. (In Japanese.)

Elemental Ti-(5, 10, 32 and 64)wt%Al powders were mechanically alloyed in Ar for 100 hours. The powder with 64%Al was solid solution. There was amorphization in the other mixtures. Ti-64%Al was consolidated by spark plasma sintering. The other alloys were mixed with Al before consolidation. Sintered materials had a fine, homogeneous microstructure.

Tungsten

APPARENT REVERSIBILITY OF THE βW TO αW TRANSFORMATION

E.Hegedius *et al.* (Research Inst. for Technical Physics, Budapest, Hungary.) *Int. J. Refractory Metals Hard Mater.*, Vol 16, No 1,1998, 31-35.

An experimental study of the reversibility of the transformation of αW to βW, with a modelling approach, is described. Use was made of W-O and W-O-K systems in the experiments. It is shown that αW can be transformed into βW by an oxidation/reduction cycle in the W-O-K system. Oxidation of W-K gives a W-K bronze intermediate which is reduced in H to βW.

EVAPORATION OF K DURING SINTERING OF DOPED W

A.Gruger *et al.* (Forschungzentrum Jülich GmbH, Jülich, Germany.) *Int. J. Refractory Metals Hard Mater.*, Vol 16, No 1, 1998, 37-44.

An investigation of the loss of K during sintering, by resistance heating in ultra-high vacuum, of doped W, is described. Mass spectroscopy allowed measurement of evaporated K and also Si and Al. Standard sintering regimes were used with various dwell times. A model for loss of K was developed and good agreement with experiment is reported.

VAN DER WAALS MODEL FOR POTASSIUM IN W

A.Nagy. (GE Lighting Tungsram Rt, Budapest, Hungary.) *Int. J. Refractory Metals Hard Mater.*, Vol 16, No 1, 1998, 45-49.

Theories for K bubble structure in W are discussed with reference to mono- and two-phase states for which deformation characteristics should differ. Using a model for deformation it is shown that a single bubble breaks up during mechanical processing. Disagreements between current theories and experiment are attributed to this. Calculations are used to show that K bubble structure can be influenced by processing procedures.

MICROSTRUCTURAL EVOLUTION DURING THERMOMECHANICAL PROCESSING OF NON-SAG W

I.Gaal, L.Toth. (Research Inst. for Technical Physics, Budapest, Hungary.) *Int. J. Refractory Metals Hard Mater.*, Vol 16 No 1,1998, 59-70.

Creep and microstructural evolution in non-sag W are discussed with consideration given to detachment of dislocations from bubbles, leading to variable stress sensitivity, bubble size and distribution, recrystallization and length of bubble rows. It is suggested that a recently developed model is effective only if dispersoids are nanosized. A

method for monitoring long range residual stress relaxation in thin non-sag W wires is described.

Coatings

PROCESSING CHARACTERIZATION AND PERFORMANCE OF HIGH VELOCITY OXY-FUEL SPRAYED COATINGS

D.G.McCartney. (University of Nottingham, Nottingham, UK.) *Powder Metall.*, Vol 41, No 1, 1998, 14-15.

Development of a high velocity oxygen-gaseous fuel thermal spray technique is reported. This is said to offer new oportunities for research through evaluation of coating characteristics, by a wide range of techniques, including wear and corrosion testing.

USE OF CHROMIUM CARBIDE IN THERMAL SPRAY AND OTHER COATING TECHNOLOGIES

J.Ellis. (London and Scandanavian Metallurgical Co Ltd, Rotherham, UK.) *Powder Metall.*, Vol 41, No 1, 1998, 18-20.

It is reported that a Cr_2C_3 powder, originally developed for cutting tool applications, had been used as a constituent of powders for thermal spraying. The coatings containing Cr_2C_3 are said to be an environmentally friendly alternative to hard Cr plating for wear and corrosion resistant applications.

Composite materials

TITANIUM ALUMINIDE COMPOSITES FROM COMBUSTION REACTION PROCESSING

H.Mabuchi *et al.* (Osaka Prefecture University, Sakai, Japan.) *J. Jpn Soc. Powder Powder Metall.*, Vol 44, No 6, 1997, 535-541 (In English.)

TiAl-TiB_2-Ti_2AlC composites were prepared from Ti-Al-B_4C powders by combustion reaction processing and were homogenized by arc melting. The composite so produced contained 14vol% of reinforcements. In the as-synthesized state the matrix was a lamellar structure of TiAl-Ti_3Al. Ti_3Al decomposed on arc melting and the matrix was then TiAl. Mechanisms of structure evolution are suggested. The composite material had high strength at ambient temperature and 900°C (900 and 500 MPa respectively), with 0.8% elongation at ambient temperature.

EFFECT OF NITROGEN ON TITANIUM ALUMINIDE COMPOSITE MATERIALS

T.Abe *et al.* (Tohoku National Industrial Research Inst., Sendai, Japan.) *J. Jpn Soc. Powder Powder Metall.*, Vol 44, No 6, 1997, 542-546. (In Japanese.)

It is reported that the introduction of N during mechanical alloying of Ti-Al aids alloying. Ti_2AlN was found in sintered materials. It is suggested that the nitride will strengthen the alloy if sufficiently finely dispersed. N was also introduced during MA of elemental Ti-Al-B powders which were consolidated by activated plasma spark sintering. N was found to enhance amorphization of the powder and TiB_2 was formed. Young's modulus and hardness were increased. Excessive nitride led to heterogeneous microstructures.

MECHANICAL PROPERTIES AND OXIDATION OF TWO PHASE ALUMINIDES CONTAINING TITANIUM CARBIDE

Y.Doi *et al.* (Toyama Industrial Technology Centre, Takoaka, Japan.) *J. Jpn Soc. Powder Powder Metall.*, Vol 44, No 6, 1997, 570-576. (In Japanese.)

Two phase intermetallic materials, βNiAl-γNi_3Al, containing TiC particles were fabricated by hot pressing from powders milled under various conditions. Microstructures, mechanical properties and oxidation were investigated. The highest bend strength attained was 2100 MPa at 400°C for an alloy with 30vol% TiC.

INTERMEDIATE PHASE AT MATRIX-REINFORCEMENT INTERFACE IN SINTERED ALUMINA-STEEL COMPOSITES

W.Aihua *et al.* (Wuhan Iron and Steel PM Co, China.) *Science of Sintering*, Vol 29, No 1, 1997, 27-32.

It is reported that an intermediate phase had been found at the matrix-reinforcement interface in sintered steel-Al_2O_3 composites. This is shown to give tight bonding at the interface. Rockwell hardness of the composite is reported to be 62C and the wear resistance to be 40 times greater than the matrix alloy alone.

Electrical and magnetic materials

DISPERSION OF TUNGSTEN CARBIDE PARTICLES IN SILVER-NICKEL ALLOY POWDER BY ELLIPTICAL ROTOR MILL

M.Satoh *et al.* (Osaka Prefecture University, Sakai, Japan.) *J. Jpn Soc. Powder Powder Metall.*, Vol 44, No 6, 1997, 618-621. (In Japanese.)

Production of Ag-Ni-WC powder for electrical contact applications, by blending in a high speed elliptical rotor mill, is described. Effects of operating conditions on dispersion and compounding of the powders were established.

Hard materials and tool steels

SYNTHESIS AND PROCESSING OF SUPERHARD C-N SOLIDS

A.K.Sharma, J.Narayan. (North Carolina State University, Raleigh, USA.) *Int. Materials Rev.*, Vol 42, No 4, 1997, 137-154.

Carbon-nitrogen compounds, which are predicted to have bulk moduli and hardness comparable with diamond, are reviewed with reference to theoretical and experimental developments. Progress in these and synthesis and characterization of C-N materials are described. Based on evaluation of studies to date suggestions are made for future work on crystalline and amorphous C-N materials.

Intermetallic materials

EFFECTS OF IMPLANTATION OF CHROMIUM, CERIUM AND ALUMINIUM ON OXIDATION OF TRI-NICKEL ALUMINIDE

P.Perez *et al.* (CENIM (CSIC), Madrid, Spain.) *Rev. Metall. Madrid*, Vol 34, No 1, 1998, 18-28. (In Spanish.)

Effects of implantation of Cr, Ce and Al on oxidation of PM Ni_3Al, in the range 635 to 1020°C, were investigated, by discontinuous thermogravimetric analysis, to determine kinetics, and by characterization of the scales formed. Cr is shown to enhance oxidation resistance up to 930°C, by formation of a self-healing $(Cr,Al)_2O_3$ layer. Implantation of Al has little effect, and Cr was detrimental. Above 930°C the non-implanted aluminide had the smallest weight gains.

FABRICATION OF MOLYBDENUM SILICIDE BY PULSE DISCHARGE PRESSURE COMBUSTION SYNTHESIS

R.Watanabe *et al.* (Tohoku University, Sendai, Japan.) *J. Jpn Soc. Powder Powder Metall.*, Vol 44, No 6, 1997, 530-534. (In Japanese.)

Mo-Si and Mo-Si-Nb powders were fabricated by a pulse discharge-pressure-combustion synthesis technique. Nb was added to improve ductility of the Mo-Si materials. There was marked contraction of compacts at 1050°C, showing that this was the reaction temperature. Sintered materials had 96 to 98% density and ultrasonic testing showed them