abstracts

LITERATURE REVIEW

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Powder production and preparation

Powder production efficiency of a convergent/divergent close coupled gas atomiser nozzle

R Ünal. (Dumlupinar University, Kutahya, Turkey.) Powder Metall., Vol 50, No 4, 2007, 302-306.

A close coupled annular slit nozzle for gas atomisation is discussed with regard to efficient powder production and finest particle sizes. Pure Sn powder was atomised in N. The smallest particle size was obtained with highest efficiency when atomising pressure reached the maximum aspiration pressure. This is the most efficient operating condition. Further increase in atomising pressure did not reduce particle size. Relatively low pressures were employed.

Property modification of ball milled slurries by wet-jet milling

Y Hotta et al. (National Inst. for Advance Industrial Science and Technology, Nagoya, Japan.) J. Jpn. Soc. Powder/Powder Metall, Vol 55, No 1, 2008, 21-25. In English.

Wet-jet milling was used to modify the properties of ball milled Al_2O_3 slurry. The viscosity of ball milled slurry increased rapidly with time, jet milling made the viscosity of the slurry much more stable. Ball milled (only) slurry produced OH- ions on the surface and these were removed by wet-jet milling. Jet milled slurry showed less flocculation and a packing density 60% higher than slurry ball milled only.

Preparation of fine iron powder by reduction at low temperature

Wang Xing-qing, Zhong Jun-hua. (Shanghai University, Shanghai, China.) PM Industry, Vol 17, No 6, 2007, 14-18. In Chinese.

μm and nm Fe_2O_3 powder was prepared by high energy ball milling and reduced to Fe by H at a range of temperatures. Powders were characterised for particle size distribution, morphology and %O to establish optimum process conditions. The fine milled powder had high surface activity and could be reduced at 200°C. Fe powder, 0.2 to 0.4μm in size was made from 0.35μ Fe_2O_3 powder at 360°C in 125 minutes with near 100% yield.

Preparation of copper nanoparticles by chemical reduction with ultrasonic action

Yu Meng-jiao et al. (Lanzhou University of Technology, Lanzhou, China.) PM Industry, Vol 17, No 6, 2007, 19-23. In Chinese.

$CuSO_4$ in aqueous solution was reduced to Cu by reaction with $(NH_{2)2}$, with NaOH to control pH, a surfactant and ultrasonic action. Effects of process variables on powder characteristics were investigated. Particles, mean size 40nm, were spherical, with a narrow particle size distribution and surfaces free from oxide.

Carbothermal reduction of tungsten oxide powders coated with hydrocarbons

M Selecká et al. (Inst. of Materials Research SAS, Košice, Slovak Republic.) Powder Metall. Progress, Vol 7, No 4, 2007, 221-229.

Carbothermal reduction of WO_3, coated with hydrocarbons and graphite, was investigated at 20 to 1000°C at different heating rates, using thermogravimetric analysis. Reduced powder was examined by X-ray structural analysis. The method of applying the coating influenced the kinetics of reduction. Reduction of the coated powders was more rapid than with mixed powders. The process is summarised as reduction to W and carburisation to WC and is complete in 30 minutes at 1000°C irrespective of heating rate.

Sintering

Microwave sintering of barium titanate

S R Murphy et al. (Osmania University, Hyderabad, India.) Scripta Mater., Vol 59, No 5, 2008, 495-498.

Nanosized $BaTiO_3$ powder was synthesised by a microwave hydrothermal technique and microwave sintered at 950, 1050 and 1150°C for 30 minutes in air

and conventionally sintered at 1250°C for three hours in air. Materials were characterised by a range of methods.

Fundamentals

'Parking' and packing problems in particulate materials processing

R M German. (Mississippi State University, Starkville, USA.) Powder Metall., Vol 50, No 3, 2007, 260-270.

Packing of particles in a die is discussed and an analogy is drawn with parking of automobiles in terms of space filling steps. Geometry and kinetics associated with parking simulation are considered and generalised to 3-dimensional particle structures. Data is extracted from parking simulations to show how powder filling of a container follows a log-normal pore size distribution. Applications of the study are described.

An 'old' technique reborn for nanoparticle size analysis

H Vegad. (Analitik Ltd., Biggleswade, UK.) Powder Metall., Vol 50, No 4, 2007, 291-293.

Differential centrifugal sedimentation is shown to be a valuable technique for analysis of particle size distribution in the range 3nm to 80µm, notably for samples with a narrow distribution. It can detect small changes in distribution. The method uses size separation and measurement without use of predictive algorithms. The method has been developed through improvements in instrumentation. The method is said to be rapid and accurate.

Analysis of porous structures of crystalline particles by sintering simulation

H Nomura et al. (Japan Fine Ceramics Centre, Nagoya, Japan.) J. Jpn. Soc. Powder/Powder Metall, Vol 55, No 1, 2008, 3-9. In Japanese.

Sintering and grain growth of solid grains was modelled using 3-dimensional lattice to analyse effects of surface energy of particles and development of porosity is sintered materials. Changes of porosity, grain diameter fraction of connected pores and solid contiguity were examined in respect of surface energy. Introduction of anisotropic surface energy increased porosity and decreased mean grain diameter and contiguity. This was more noticeable for small initial particle sizes. The results are applicable to attaining fine and stable pore size structures in sintered materials.

Particle filling and size effects on ball load behaviour and power in a dry mill

K K Kiangi, M H Moys. (University of the Witwatersrand, Johannesburg, South Africa.) Powder Technol., Vol 187, No 1, 2008, 79-87.

Ball/load behaviour in a ball mill, under conditions of increasing filling was investigated using SiO_2 particles 0.075 to 0.3, 0.8 and 1.8mm in size at various mill speeds. A probe was placed in the mill to obtain data independent of particles in the mill. Differences in powder drawn by the mill, as a function of particle size is discussed. There was segregation of coarser particles to the periphery of the charge. A radial index for segregation is deduced and used to quantify segregation as a function of mill speed and particle loading.

Aluminium

Phase transformation induced by nitriding quasicrystalline aluminium alloy powders

V Fourneé et al. (Ecole des Mines, Nancy, France.) Scripta Mater., Vol 59, No 6, 2008, 583-586.

It is shown that quasicrystalline Al-Cu-Fe-B powders undergo phase transformations when annealed in N. A thick AlN layer forms on the surface, depleting the matrix of Al. The quasicrystalline phase changes to a cubic βphase and then to a monoclinic λphase. The process is more rapid than oxidation.

Properties of Al composites reinforced with submicron aluminium nitride particles

Jianhua Wang et al. (Xiangtan University, Xiangtan, China.) Materials/Design, Vol 30, No1, 2009, 78-81.

Al-AlN powders were dry or wet mixed/milled. It is shown that a dispersant, $(CH_3)_2CO$, prevented oxidation and impeded granulation of the powders during wet mixing/milling. Al-AlN composites were made from wet mixed/milled powder by cold isostatic pressing and hot extrusion. Mechanical properties and thermal expansion are compared with pure Al.

Beryllium

Tensile test and scanning electron microscopy in situ fatigue tests of beryllium-aluminium

Qu Xuanhui et al. (University of Science and Technology, Beijing, China.) PM Technology, Vol 25, No 3, 2007, 163-166. In Chinese.

Fatigue tests, inside a scanning electron microscope and tensile tests were carried out to measure properties of Be-Al alloy at ambient temperature. Tensile properties were strain rate sensitive and fractures were ductile in Al regions and brittle cleavage in Be zones. Fractures showed that cracks initiated in Be and propagated in the Al matrix. Fatigue fractures were also mixed ductile and brittle cleavage.

Cobalt

Quantitative metallographic investigation of mechanical alloying of cobalt-iron

G Arghir et al. (Technical University of Cluj-Napoca, Cluj-Napoca, Romania.) Powder Metall. Progress, Vol 7, No 4, 2007, 230-237.

Co-5%Fe nanopowders were produced by mechanical alloying for 12 hours. The powders were characterised by X-ray diffraction and quantitative metallography. Mean particle size was 21nm and the material was a solid solution with equiaxed grains with irregular surfaces, caused by cracking during milling.

High energy milling and spark plasma sintering of cobalt base superalloy

C F Tang et al. (Tsinghua University, Beijing, China.) J Mater. Process. Technol., Vol 204, No 1-3, 2008, 111-116.

A Co base superalloy was prepared from powder by high energy milling and spark plasma sintering. Structure and properties were investigated. Particle and crystallite size decreased with increase in milling time but the rate of change slowed down after eight hours. 1.5% CH_3OH inhibited granulation. Spark plasma sintering attained 99.2% density at 1100°C and 40MPa. Microstructure was fine with grain size less than 5µm. Compressive strength was 2506MPa with 2.5% contraction. Annealing reduced strength to 1982MPa