Selected Abstracts of Thermal Spray Literature 12/90 - 12/91

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Application

Abradables

THSP Coatings Save Aircraft Engines. Thermally sprayed (THSP) abradable-seal coatings in aircraft engines are porous with low strength, but resist impact from abrasive particles moving at high speed through the engine. The coating materials are multicomponent powders deposited by combustion (flame) and high-velocity oxyfuel spray. The selection of seal materials for the various sections of a gas turbine engine depends upon the local operating temperature (600-2500°F) (315-1370°C) and coating materials which include Al alloy/polyester, Al alloy/graphite, Ni/graphite, Ni—Cr—Fe—Al—BN composite, Ni—Cr—Al—Bentonite and Ni—Al coating. The coating requirements for next generation turbine engines for long service > 2000°F (1095°C) are highlighted.

E.R. Novinski. Cited: Perkin-Elmer. *Weld. Des. Fabr.*, Apr. 1991, 64, (4), 26-28, [in English]. ISSN 0043-2253. PHOTOCOPY ORDER NUMBER: 9108-570989.

Aircraft

Surface Coatings Technology for Turbine Engine Applications. A brief historical review is given on the use of coating systems in aircraft turbine engine applications. Typical coating systems by engine section are then discussed giving a description of the material, coating process and environmental challenges for each area. These systems include: Codep, a simple aluminide pack cementation system; CVD to coat aluminide on internal and external surfaces; electron beam PVD; vacuum plasma spray; air plasma deposition of ceramic; and ceramic physical vapour deposition. Coating systems in gas turbine engines provide protection against high temperature oxidation corrosion, and wear and erosion. Additionally, abradable coatings are used in seal systems. Graphs.

D.M. Comassar. Cited: General Electric Aircraft Engines. *Met. Finish.*, Mar. 1991, 89, (3), 39-44, [in English]. ISSN 0026-0576. PHOTOCOPY ORDER NUMBER: 9108-570959.

General Review

HVOF-Spray Technology—Poised for Growth. HVOF (high-velocity oxyfuel) thermal spraying is a method for applying coating powders onto a substrate at very high velocities, flattening the particles into a denser and more wear-resistant coating than possible using alternative spraying processes such as plasma spraying. The process has been used on gas-turbine aircraft engine components including compressor vanes and blades, bearing housings, and shrouds. The four major domestic HVOF-coating services are doing an estimated $80 million business annually. HVOF produces higher coating bond strength, lower oxide content, and improved wear resistance over plasma sprayed coatings. From the original tungsten-carbide coatings, the list of coatings has expanded to include Tribaloys T-800 and T-400, chromium carbides, Inconel 718, Hastelloy C, Cu—Ni—In, and Al—polyester. Effective masking materials and better methods for reducing heat transferred into the part are still needed to improve cost-effectiveness. Photomicrographs.

D.W. Parker and G.L. Kutner. Cited: General Plasma. *Adv. Mater. Process.*, Apr. 1991, 139, (4), 68, 72, 74, [in English]. ISSN 0882-7958. PHOTOCOPY ORDER NUMBER: 9107-570836.

Heat-Reflecting

Thermal Stability of Heat-Reflecting Ceramic Coatings on Specimens Made of Aluminum Alloys. The thermal stability of plasma-sprayed ceramic (e.g. ZrO_2—6CaO) coatings deposited on the end surfaces of cylindrical specimens of Al alloys D16, AL9, and AL26 was investigated as a function of the sublayer material and ceramic composition. The sublayer materials included Fe- and Ni-based thermoreactive composites, intermetallics, and refractory alloys. It is shown that, in the case of ZrO_2—6CaO ceramic, the highest heat resistance is achieved with a sublayer based on the VKNA refractory alloy. Graphs. 2 ref.

V.G. Ivanov, V.P. Nikitin, and A.M. Yatsechko. Cited: Central Scientific Research Institute of Materials Research. *Svar. Proizvod.*, Dec. 1990, (12), 11-12, [in Russian]. ISSN 0491-6441. PHOTOCOPY ORDER NUMBER: 9108-570966.

Magnesium Alloy Repair

[Electric Arc Spray Deposition to Repair Magnesium Parts.] A safer way to repair Mg alloy components such as aircraft engine housings relies on use of a Ni—Al alloy applied by electric arc spray. The system, sold by Hobart Tafa Technologies, Concord, New Hampshire, USA, puts a strongly bonded (9500 psi bond strength) layer of the Ni—Al alloy onto the part but holds substrate temperatures to ~ 150°F (66°C). No hazardous flames are involved with the arc-spray method, and oxides that might impair bond strengths do not form. (News Brief).

Cited: Hobart Tafa. *Adv. Mater.*, 13 May 1991, 5, [in English]. ISSN 0734-7146. PHOTOCOPY ORDER NUMBER: 9108-G50192.

Mold Coating

Mold Coatings Boost Tool Performance. Mission-critical plastic carbon/Kevlar composite components are produced by molding and curing in ceramic coated Al molds. To reduce wear of the Al mold by the abrasive reinforcing fibers in the composite component, to reduce mold rework time and to preserve close tolerances on components, a proprietary synergistic mold coating was developed by General Magnaplate Corp. The process combines the advantages of anodizing, hard-coat plating or plasma spray methods with the controlled infusion of low friction polymers. The coating has a hardness of R_c 70 an exhibits excellent release characteristics. It is used in production at McDonnell-Douglas.

C.A. Covino. Cited: General Magnaplate. *Tool. Prod.*, Mar. 1991, 56, (12), 59-69, 60, [in English]. ISSN 0040-9243. PHOTOCOPY ORDER NUMBER: 9109-571125.

Superconductivity

Forming High-Tc Superconductors. Within the framework of the National Research Program High-Tc Superconductors, the Netherlands Energy Research Foundation carried out research on manufacturing bulk superconductors as a wire, plate, or as a pipe. The preparation of $YBa_2Cu_3O_7$ related compounds and BiCaSrCuO by means of citrate pyrolysis and some other preparation methods are discussed. An overview is given of the mechanical and temperature treatment, and of the analyses of the powders. The following ceramic forming techniques were studied: pressing (uniaxial, cold isostatic), tape casting, extrusion, slip casting, and plasma spraying. 6 ref.

L.P.L. Rabou, A. Roskam, H.C.D. Smit, and H.J. Veringa. Cited: Netherlands Energy Research Foundation ECN. DE91760568/XAB, Dec. 1990, Pp 53, [in Dutch]. PHOTOCOPY ORDER NUMBER: 9109-F21910C.

Thermal Barriers

Thermal Barrier Coatings for Heat Engines. This state of the art review of thermal barrier coatings examines the literature, current practices and applications. It offers information on the physical properties of various types of ceramics used in coatings and their mode of application. Particular attention is paid to plasma sprayed ZrO_2 and the opportunities for enhancement of performance by the use of two layers (ZrO_2 + Y_2O_3) deposited on a base coating of Ni—Cr—Al—Y. 24 ref.

H.-D. Steffens and R. Kaczmarek. *Weld. World*, 1990, 28, (11-12), 224-230, [in English]. ISSN 0043-2288. PHOTOCOPY ORDER NUMBER: 9109-571201.

Wear Resistance

Quasicrystalline Low-Friction Coatings. Quasicrystalline powders of $Al_{65}Cu_{20}Fe_{15}$ and $Al_{64}Cu_{18}Fe_8Cr_8$ were prepared and sprayed onto Cu, Al alloys, and carbon steel to study their effects on wear resistance. The sprayed powders changed from pure quasicrystalline to a mixture of quasicrystalline and crystalline phases. These coatings are also relatively stable with temperatures up to 530°C. Mechanical tests were scratch tests with progressive loading and constant loading of the indenter. All data indicate potential applications for mild wear re,isstant coatings since the coatings have low friction coefficients and provide wear resistance to soft metals comparable to that of mild steel. Graphs, Diffraction patterns, Photomicrographs. 21 ref.

J.M. Dubois, S.S. Kang, and S. Von Stebut. Cited: Ecole Nationale Supérieure des Mines de Nancy. *J. Mater. Sci. Lett.*, 1 May 1991, 10, (9), 537-541, [in English]. ISSN 0261-8028. PHOTOCOPY ORDER NUMBER: 9109-581075.

Investigations of Sliding Friction and Wear on Plasma Sprayed Coatings and Laser-Remelted Plasma Sprayed Coatings. Material samples of case-hardening steel C 15 to the surface of which NiCr alloy layer was applied by plasma spraying, were investigated in a tribological system. On some of the material samples, the spray coatings were remelted by means of a laser beam. From the results of the sliding friction and wear investigtions it can be concluded that the wear behaviour of plasma spray coatings is scarcely affected by the applied counter body. However, in the case of the laser-remelted plasma spray coatings the wear may be optimized in dependence of the applied counter body. Graphs, Photomicrographs. 7 ref.

I. Haase, R. Ranke, G. Eckart, and V. Heinz. Cited: Institut für Materialforschung und Anwendungstechnik and Technische Universität Dresden. *IfL-Mitt.*, Jan.-Feb. 1991, 30, (1), 19-26, [in German]. ISSN 0018-9693. PHOTOCOPY ORDER NUMBER: 9109-314052.

Biomedical

Hydroxyapatite

Influence of Surface Characteristics on Bone Integration of Titanium Implants. A Histomorphometric Study in Miniature Pigs. The purpose of the present study was to evaluate the influence of different surface characteristics on bone integration of Ti implants. Hollow-cylinder implants with six different surfaces