JTTEE5 16:337–341
DOI: 10.1007/s11666-007-9066-z
1059-9630/$19.00

Selected Patents Related to Thermal Spraying

Issued between January 1, 2007 and March 31, 2007

Prepared by Jiří Matějíček, Institute of Plasma Physics, Za Slovankou 3, 18200 Praha 8, Czech Republic; jmatejic@ipp.cas.cz; Tel.: +420-266 053 307. Adapted with permission from Delphion, http://www.delphion.com/.

CA denotes Canadian patent, EP denotes European patent, GB denotes British patent, RU denotes Russian patent, US denotes United States patent, WO denotes World Intellectual Property Organization application. The information has the following format: Title, Abstract, Patent number, Inventors, Company, Issued/Filed dates.

Applications

Coatings, Coated Articles, and Methods of Manufacture Thereof. A multilayer coating is particularly useful for the coating of implants such as orthopedic and dental implants, particularly metallic implants. The first layer comprises a bond coating of a dense material insoluble and inert in body fluids. The second layer comprises apatite and a binder. The first layer protects the metallic implants from corrosion, apatite dissolution, and interfacial reaction with apatite and the binder. The apatite in the second layer is a bioactive agent that can osteobond to tissue. The binder allows adjustment of the thermal expansion coefficient between the coating and the metallic substrate. This multilayer coating has both high bond strength to implants and excellent bioactivity with the surrounding body tissue.

US 7157096: Z. Zhang and T.D. Xiao. Company: Inframat Corp. Issued/Filed: Jan 2, 2007/Oct 14, 2002.

Conformal Coverings for Electronic Devices. A method of making a conformal covering for an electronic device, the method comprising: providing a template representative of a shape of at least a portion of an electronic device; forming a radio-opaque coating on at least a portion of a surface of the template by a thermal spraying process; and separating at least a portion of the coating from the template so as to form the conformal covering.

WO 27027726: W.J. Dalzell and K.H. Heffner. Company: Honeywell International, Inc. Issued/Filed: March 8, 2007/Aug 29, 2006.

Improved Coating Blade. Improved coating blades are disclosed, as well as processes for manufacturing such blades. The inventive blades have an intermediate edge deposit effective to reduce heat transfer from a wear-resistant top deposit to the blade substrate. In one embodiment, the intermediate layer comprises NiCr, possibly with embedded oxide particles. Suitably, the intermediate layer and the top deposit are applied by an HVOF process. It is also envisaged that the intermediate layer may be deposited by plasma spraying. The intermediate layer may comprise stabilized zirconia.

WO 27003332: S. Freti and J.-F. Laithier. Company: BTG Eclepens S.A. Issued/Filed: Jan 11, 2007/June 29, 2006.

Insert Casting Component, Cylinder Block, Method for Forming Coating on Insert Casting Component, and Method for Manufacturing Cylinder Block. A liner outer surface is coated by a sprayed layer or a heterogeneous metal layer including a base metal phase and dispersed metal phases. During casting, liquid metal enters the sprayed layer from the dispersed metal phases and solidifies in a virtual vegetation root state. The surface of the cylinder block is thus rigidly fixed to the surface of the cylinder liner. In this case, a strong bonding force is produced between the cylinder block and the cylinder liner and high thermal conductivity is obtained compared to the prior art in which the liquid metal merely contacts a surface layer.

WO 27007826: N. Miyamoto, M. Hirano, T. Takami, K. Shibata, N. Yamashita, T. Mihara, G. Saito, M. Horigome, and T. Sato. Company: Toyota Jidosha Kabushiki Kaisha. Issued/Filed: Jan 18, 2007/July 6, 2006.

Insulated Cylinder Liner for a Marine Engine. An engine is made by providing a layer of material between the outer surface of a cylinder liner and the inner surface of the cylinder opening within an engine block. The material can be a polymer or a ceramic. Polyether etherketone or polyethylene terephthalate can be a polymer used for these purposes. Zirconia or yttria can be ceramic used for these purposes. An electrodeposited paint can serve as the layer of thermally insulative material.

US 7191770: K.R. Anderson, E.S. Mueller, C.J. Misorski, and M.B. Sheth. Company: Brunswick Corporation. Issued/Filed: March 20, 2007/June 7, 2005.

Method of Connection of Steel Parts. Invention relates to method of welding of steel parts with subsequent protection of weld seams and near-seam zones from intensive corrosion. Method includes machining of edges of steel parts to be welded to prepare them for welding, assembling for welding, welding of edges of steel parts, and application of protective coating on zone of welding. Steel parts are connected by argon-arc welding. Coating is applied after welding by plasma spraying onto weld seam and zone of its thermal influence after cooling of welding zone lower than weld seam melting temperature. Plasma spraying is done with same material as that of connected parts. Effect: improved reliability of protection of welding zone from local corrosion owing to equalizing chemical potentials, exclusion of formation of anode and cathode sections, and simplified creation of protective coating.

RU 2293632: B.Zh. Mikhailovna, V.A. Valer'evich, C.M. Iosifovich, and S.D. Aleksandrovich. Company: KUBGTU. Issued/Filed: Feb 20, 2007/June 6, 2005.

Method for Producing Carbon Composite Materials by Plasma Pyrolysis and Thermal Spraying. The invention describes a method for producing carbon composite materials by pyrolysis and thermal spraying, in which method a material obtained at least partly from renewable raw materials is transformed by means of pyrolysis into a porously lattice-like matrix, and this matrix is subsequently filled at least partially with an infiltration material by means of thermal spraying methods. Here, the pyrolysis of the material by means of a thermal spraying method is carried out until the porously lattice-like matrix of the carbonized material has formed, at least in certain regions, and subsequently at least the carbonized regions with the porously lattice-like matrix are coated with an infiltration material, or are at least partially filled by an infiltration material, likewise by means of thermal spraying methods.

WO 27028358: W. Tillmann and E. Vogli. Company: Universitaet Dortmund. Issued/Filed: March 15, 2007/Aug 25, 2006.

Method of Producing a Protective Coating, Protective Coating, and Component with a Protective Coating. The present invention relates to a method of producing a wear-, heat-, and corrosion-resistant protective coating for a component, in particular for components of a gas turbine, by means of thermal spraying, wherein, during the application of the protective coating, consisting of ceramic and/or a carbide/metal combination, to the component, structuring of that surface of the protective coating that faces away from the component is effected to produce an abrasive surface. In addition, the invention relates to a protective coating, namely a wear-, heat- and corrosion-resistant protective coating for a component, in particular for components of a gas turbine, having an abrasive surface. In this case, the protective coating is formed in a single layer and is produced by the method according to the invention. In addition, the invention relates to a component, in particular a component of a gas turbine, having a protective coating.

WO 27033650: C. Friedrich and K. Breitschwerdt. Company: MTU Aero Engines GmBH. Issued/Filed: March 29, 2007/Sept 16, 2006.

Method of Repairing a Ni-Base Alloy Part. The present invention relates to a method of repairing a Ni-base alloy part having an undercoat layer and a top-coat layer stacked on a Ni-base alloy base when the top-coat layer is damaged, comprising the steps of removing a peeled-off portion of the damaged top-coat layer and a denatured portion of the undercoat layer corresponding to the peeled-off portion, forming another undercoat layer by applying spraying to an opening portion of the undercoat layer in the atmosphere at a spray particle speed of 300 m/s or more and a base-material temperature of 300 °C or less, and forming another top-coat layer in the peeled-off portion of the top-coat layer.

US 7172787: T. Torigoe, I. Okada, K. Takahashi, M. Ohara, K. Yamaguchi, and S. Aoki. Company: Mitsubishi Heavy Industries, Ltd. Issued/Filed: Feb 6, 2007/Dec 12, 2003.

Method for Repairing Titanium Alloy Components. A method for repairing a titanium alloy surface of a turbine component includes the step of cold gas dynamic spraying a powder material comprising at least one titanium alloy directly on the titanium alloy surface. The method may further include the steps of hot isostatic pressing the cold gas dynamic sprayed turbine component and performing a separate heat-treating step after the hot isostatic pressing. Thus, the cold gas dynamic spray process and postspray processing can be employed to effectively repair degraded areas on compressor turbine components.

WO 27027177: Y. Hu, M. Floyd, C.L. Cahoon, and F. Renteria. Company: Honeywell Intl. Inc. Issued/Filed: March 8, 2007/Aug 30, 2005.

Method for Thermal Spray Coating and Rare Earth Oxide Powder Used Therefor. The invention discloses an efficient method for the formation of a highly corrosion- or etching-resistant thermal spray coating layer of a rare earth oxide or rare earth based composite oxide by a process of plasma thermal spray method by using a unique thermal spray powder consisting of granules of the oxide. The thermal spray granules are characterized by a specified average particle diameter of 5-80 μm with a specified dispersion index of 0.1-0.7 and a specified BET specific surface area of 1-5 m^2/g as well as a very low content of impurity iron not exceeding 5 ppm by weight as oxide. The flame splat powder used here is characterized by several other granulometric parameters including globular particle configuration, particle diameter D90, bulk density, and cumulative pore volume.

EP 1167565: T. Tsukatani, Y. Takai, and T. Maeda. Company: Shin-Etsu Chemical Co., Ltd. Issued/Filed: March 7, 2007/June 25, 2001.

Reinforced Concrete Structure. A metal coating of typically a valve metal, especially a titanium metal coating, is applied by thermal spraying to the surface of concrete, most particularly steel-reinforced concrete. The metal such as titanium may be sprayed by any one of several thermal spraying techniques including flame spray, electric-arc spray, plasma spray, high-velocity oxyfuel spray, or detonation gun spray. The metal coating should be tightly adhered to the concrete and desirably will have a porosity to facilitate extensive coating of the metal itself, as well as facilitate any activation that may be needed for the metal. Such activation can be in the form of an active material that allows the coating to function catalytically. One coating option is to apply a solution onto the spray-applied metal, then polarize the metal anodically to effect deposition of active material on the metal. Another option includes depositing active material directly onto the concrete, then applying an adherent, electrically conductive overlay such as a titanium metal coating to the treated concrete.

CA 2141225: C.W. Brown, Jr., J.E. Bennett, J.J. Bartholomew, B.L. Martin, and T.J. Schue. Company: Eltech Systems Corp. Issued/Filed: March 20, 2007/Jan 27, 1995.

Shielded System with a Housing Having a High Atomic Number Metal Coating Applied by Thermal Spray Technique. A radiation-shielded system and method of producing a radiation-shielded system having at least one component susceptible to disruption upon exposure to ionizing radiation, wherein the susceptible component is protected by a rigid housing having a metallic layer of high atomic number that is deposited on the surface of the housing using a thermal spray technique.

US 7163752: J.E. Coker and M.G. Prlina. Company: The Boeing Co. Issued/Filed: Jan 16, 2007/Dec 19, 2002.

Spray Coatings for Suspension Damper Rods. Electroplated chromium coatings on automobile suspension damper piston rods are replaced with thermal or kinetic spray coatings of: (a) suitable corrosion-resistant metal alloys such as iron and chromium containing nickel-base alloys or chromium containing steels, or (b) suitable ceramic coatings such as electrically insulative alumina ceramics. The spray coatings are porous, and the metal alloy coatings usually should be sealed for corrosion protection.

EP 964180: J.R. Smith, W. Meng, and T.H. Van Steenkiste. Company: Delphi Technologies, Inc. Issued/Filed: Jan 10, 2007/May 31, 1999.

Sputtering Target with Bonding Layer of Varying Thickness under Target Material. Certain example embodiments of this invention relate to a rotatable magnetron sputtering target(s) for use in sputtering material(s) onto a substrate. In certain example embodiments, the target includes a cathode tube with a target material applied thereto via plasma spraying or the like. A bonding layer is provided on the tube, between the cathode tube and the target material. The bonding layer is thicker proximate at least one end portion of the target than at a central portion of the target to reduce the likelihood of burn-through to or of the cathode tube during sputtering.

WO 27035227: R.M. Mayer and Y. Lu. Company: Guardian Industries Corp. Issued/Filed: March 29, 2007/Aug 31, 2006.

Thermal Spray Membrane Contact Material, Contact Member and Contact Part, and Apparatuses to Which They Are Applied. A thermal spray material containing a Mo metal phase is defined. The Mo metal phase can be at least 5 vol% and may also have an alloy phase containing one or more elements selected from the group consisting of Fe, Ni, Co, Cr, Cu, and Zn. Carbides selected from the group including W, Ti, Cr, Mo, and V may also be added in an amount of 10-50 vol%; nitrides, oxides, and hard intermetallics may also be used. The thermal spray material may be used in a number of applications including: hydraulic pumps, bearing surfaces, valve apparatus, floating seal apparatus, and rock wedge crushing apparatus.

GB 2403732: T. Takayama, T. Ohnishi, and K. Okamura. Company: Komatsu Ltd. Issued/Filed: Jan 10, 2007/May 24, 2004.

Turbine and Manufacturing Method Therefor. A tip of rotor blade that rotates is an abradable surface. An inner wall of a shroud as a jacket for the rotor blade is an abrasive surface. A part of an abrasive particle protrudes from the abradable surface. When the tip of the rotor blade that rotates contacts the inner wall of the shroud, the protruding section of the abrasive particle slides with the abrasive surface so as to be ground. By doing this, a turbine can maintain an appropriate clearance between the rotor blade and the shroud and can be used for a long period under high-temperature conditions with easy restoration and remaking thereof.

CA 2411156: M. Ohara and N. Kunitake. Company: Mitsubishi Heavy Industries, Ltd. Issued/Filed: March 6, 2007/Nov 5, 2002.

Feedstock

Hardmetal Materials for High-Temperature Applications. Hardmetal compositions each including hard particles having a first material and a binder matrix having a second, different material comprising rhenium or a Ni-base superalloy. Tungsten may also be used a binder matrix material. A two-step sintering process may be used to fabricate such hardmetals at relatively low sintering temperatures in the solid-state phase to produce substantially fully densified hardmetals. A hardmetal coating or structure may be formed on a surface by using a thermal spray method.

WO 27022514: S.-R.S. Liu. Company: Genius Metal, Inc. Issued/Filed: Feb 22, 2007/Aug 21, 2006.

Methods of Making Al_2O_3-SiO_2 Ceramics. Methods for making glasses and glass-ceramics comprising Al_2O_3 and SiO_2. Glasses made according to the present invention can be made, formed as, or converted into glass beads, articles (e.g., plates), fibers, particles, and thin coatings. Some embodiments of glass-ceramic particles made according to the present invention can be particularly useful as abrasive particles.

US 7175786: A. Celikkaya and T.J. Anderson. Company: 3M Innovative Properties Co. Issued/Filed: Feb 13, 2007/Feb 5, 2003.

Thermal Spray Compositions for Abradable Seals. A thermal spray composition and method of deposition for abradable seals for use in gas turbine engines, turbochargers, and steam turbines. The thermal spray composition includes a solid lubricant and a ceramic preferably comprising 5-60 wt% total of the composition in a ratio of 1:7 to 20:1 of solid lubricant to ceramic, the balance a matrix-forming metal alloy selected from Ni, Co, Cu, Fe, and Al and combinations and alloys thereof. The solid lubricant is at least one of hexagonal boron nitride, graphite, calcium fluoride, lithium fluoride, magnesium fluoride, barium fluoride, tungsten disulfide, and molybdenum disulfide particles. The ceramic includes at least one of albite, illite, quartz, and alumina-silica.

US 7179507: P. Fiala, A.P. Chilkowich, and K. Hajmrle. Company: Sulzer Metco (Canada) Inc. Issued/Filed: Feb 20, 2007/April 28, 2005.

Pretreatment and Posttreatment

Abradable Seal. An abradable seal is provided using a laser to cut a pattern into the surface effective to improve abradability in the area of the pattern.

CA 2274526: T.A. Wolfla and J.J. Ferguson. Company: Chromalloy Gas Turbine Corp. Issued/Filed: Feb 13, 2007/Dec 5, 1997.

Method of Preparation of the Surface Before Deposition of the Plasma Coatings. The invention is pertaining to the field of deposition of coatings by the gas-thermal methods, in particular, to the plasma deposition. The invention presents the method of preparation of the surface before the plasma deposition of chromium carbonyl. The method includes realization of the electrospark doping in the carbonic gas medium with utilization of the electrode formed from the powder on the basis of chromium. The doping is conducted at the following modes: the specific duration of the doping is 2-3 min/cm^2, the discharge current is 0.6-0.9 A, the amplitude of the electrode vibrations is 60-70 μm, the frequency of the electrode vibrations is 100 Hz. The technical result of the invention is the increase of the cohesion strength of the gas-thermal coating with the substrate. Effect: the invention ensures the increased cohesion strength of the gas-thermal coating with the substrate.

RU 2294394: S.I. Petrovich, K.A. Ivanovich, Sh.M. Sergeevich, R.P. Maksimovich, M.V. Viktorovich, N.V. Nikolaevich, and V.R. Sergeevich. Company: Rjazanskij Voennyj Avtomobil'nyj Institut. Issued/Filed: Feb 27, 2007/March 28, 2005.

Spraying Systems and Methods

Method for Producing Ceramic Layers. The invention relates to a method for producing ceramic layers by spraying. A cold gas spraying method is used to produce polymer ceramics from preceramic polymers. According to said method, a cold gas stream, to which particles of the preceramic polymers are added via a conduit, is generated by a spray gun. The energy for creating a layer on a substrate is produced by injecting a powerful kinetic energy into the cold gas stream, thus preventing or significantly restricting the thermal heating of the cold gas stream. This permits the heat-sensitive preceramic polymers to be spray applied as a coating on a substrate using a cold gas spraying method. Polymer ceramics can thus be used in an economic method for the rapid production of layers with a relatively large thickness. The invention allows, for example armored layers, thermal protection layers, and other functional layers to be produced.

WO 27000422: U. Krueger and R. Ullrich. Company: Siemens AG. Issued/Filed: Jan 4, 2007/June 23, 2006.

Method of Production of the Protective Coating on the Surface of the Metal. The invention is pertaining to the field of chemical industry and food industry; in particular, the invention may be used at production on the metallic surfaces of the details of the coatings resistant to the action of the aggressive and high-temperature media, mainly of the antiadhesive coatings in the chemical engineering and the alimentary engineering. The method provides for the plasma spraying of the adhesive metallic substrate and the subsequent forming of the layer of fluoroplastic with its meltback. The plasma spraying of the adhesive substrate is exercised at the electric current intensity of 90-110 A, the voltage of 30-45 V with its subsequent heat treatment at the temperature of 650-800 °C. The meltback of the fluoroplastic coating is conducted at the temperature of 250-270 °C within 3-5 h. Then the adhesive substrate made on the basis of the copper-zinc alloy is sprayed on. The protective coating is produced on the surface of the aluminum alloy or the carbon steel. The technical result of the invention consists in the increased strength of the cohesion of the coating with the substrate due to reduction of the thermal tensions between them. Effect: the invention ensures the increased strength of the cohesion of the coating with the substrate due to reduction of the thermal tensions between them.

RU 2294398: Ch.A. Shotovich, M.V. Sergeevna, and N.O. Aleksandrovich. Company: Moskovskij Gosudarstvennij Universitet Pishchevykh Proizvodstv. Issued/Filed: Feb 27, 2007/March 21, 2006.

Plasma Spraying. Production of amorphous material used in making glass-ceramic comprises feeding particles into plasma to provide melt, and spraying and cooling melt to provide amorphous material.

US 7179526: A.Z. Rosenflanz, A. Celikkaya, and T.J. Anderson. Company: 3 M Innovative Properties Co. Issued/Filed: Feb 20, 2007/Aug 2, 2002.

System and Process for Solid-State Deposition and Consolidation of High-Velocity Powder Particles Using Thermal Plastic Deformation. The invention relates to an apparatus and process for solid-state deposition and consolidation of powder particles entrained in a subsonic or sonic gas jet onto the surface of an object. Under high-velocity impact and thermal plastic deformation, the powder particles adhesively bond to the substrate and cohesively bond together to form consolidated materials with metallurgical bonds. The powder particles and optionally the surface of the object are heated to a temperature that reduces yield strength and permits plastic deformation at low flow stress levels during high velocity impact, but which is not so high as to melt the powder particles.

US 7178744: R.M. Tapphorn and H. Gabel. Company: Innovative Technology, Inc. Issued/Filed: Feb 20, 2007/Nov 22, 2004.

A Thermal Spraying Method and Device. A thermal spraying device, comprising a means for generating a flame and a means for injecting a powder into the flame, said flame-generating means comprising an end piece out of an outlet of which the flame is directed toward a substrate subjected to spraying, and the powder-injection means comprising a frame element that projects in the flame ejection direction from the end piece, that at least partly surrounds a flame zone extending from the end piece, and that presents an inner circumference that is larger than the inner circumference of said outlet, and at least one powder port for the introduction of a powder to the flame being arranged on the inner periphery of said frame element at a distance from the outlet of the end piece as seen in the flame ejection direction. There is provided at least one gas injection opening in the frame element, said gas injection opening being located between the outlet of the end piece and the at least one powder port as seen in the flame ejection direction.

WO 6080870: J. Wigren, J. Johansson, S. Bjoerklund, and I. Choquet. Company: Volvo Aero Corp., Hoegskollan Trollhattan. Issued/Filed: Jan 25, 2007/Jan 26, 2005.

Thermal Barrier Coatings and Bond Coats

Ceramic Compositions for Thermal Barrier Coatings with Improved Mechanical Properties. Zirconia-containing ceramic compositions useful for thermal barrier coatings having improved mechanical properties, especially improved fracture toughness. These compositions comprise: (1) at least about 93 mol% zirconia; (2) a stabilizing amount up to about 5 mol% of a stabilizer metal oxide selected from the group consisting of yttria, calcia, ceria, scandia, magnesia, india, gadolinia, neodymia, samaria, dysprosia, erbia, ytterbia, europia, praseodymia, and mixtures thereof, and a fracture toughness improving amount up to about 2 mol% lanthana. These ceramic compositions can be used to prepare thermal barrier coatings to provide a thermally protected article having a substrate and optionally a bond coat layer adjacent to and overlaying the substrate. The thermal barrier coating can be prepared by depositing the ceramic composition on the bond-coat layer or the substrate in the absence of a bond-coat layer.

US 7166373: I. Spitsberg and B.A. Boutwell. Company: General Electric Co. Issued/Filed: Jan 23, 2007/Aug 19, 2004.

Gas Turbine Engine and Method of Producing the Same. A raw material powder having particle sizes of not more than 125 μm and preferably not more than 75 μm, such as a powder of an alloy of Co-32%Ni-21%Cr-7.5%Al-0.5%Y is thermally sprayed onto surfaces of shroud members of a shroud to form a coating. The high-velocity oxyfuel thermal spray method is used as the thermal spray method. In the obtained coating, the porosity is 5-30 vol% and the oxygen content is not more than 2 wt%. In particular, when the raw material powder has particle sizes of about 40 μm, it is possible to obtain a coating that has an extremely small oxygen content of about 0.5 wt%.

US 7163370: T. Kokusho. Company: Honda Motor Co., Ltd. Issued/Filed: Jan 16, 2007/Jan 23, 2004.

Low Conductivity and Sintering-Resistant Thermal Barrier Coatings. A thermal barrier coating composition is provided. The composition has a base oxide, a primary stabilizer, and at least two additional cationic oxide dopants. Preferably, a pair of group A and group B defect cluster-promoting oxides is used in conjunction with the base and primary stabilizer oxides. The new thermal barrier coating is found to have significantly lower thermal conductivity and better sintering resistance. In preferred embodiments, the base oxide is selected from zirconia and hafnia. The group A and group B cluster-promoting oxide dopants preferably are selected such that the group A dopant has a smaller cationic radius than the primary stabilizer oxide, and so that the primary stabilizer oxide has a small cationic radius than that of the group B dopant.

US 7186466: D. Zhu and R.A. Miller. Company: Ohio Aerospace Institute, NASA. Issued/Filed: March 6, 2007/ Nov 17, 2005.

Method for Modifying Gas Turbine Nozzle Area. A method of modifying a turbine nozzle area comprises depositing a thermal barrier coating (TBC) on the nozzle endwalls to provide a minimum nozzle area, evaluating an airflow through the nozzle, and machining the TBC to increase the nozzle area. Adjacent segment area variation may be minimized, improving engine reliability by reducing the aerodynamic excitation to the down stream blade.

US 7186070: M.C. Morris, T.E. Strangman, C.A. Wilson, G.W. Wolfmeyer, S.H. Halfmann, and D.K. Jan. Company: Honeywell International, Inc. Issued/ Filed: March 6, 2007/Oct 12, 2004.

Multiphase Thermal Barrier Coatings for Very High Temperature Applications. A device having a ceramic thermal barrier coating layer characterized by a microstructure having gaps with a sintering inhibiting material disposed on the columns within the gaps. The sintering-resistant material is stable over the range of operating temperatures of the device and is not soluble with the underlying ceramic layer. For a YSZ ceramic layer the sintering-resistant layer may preferably be aluminum oxide or yttrium aluminum oxide, deposited as a continuous layer or as nodules.

EP 1418252: S.M. Sabol and R. Subramanian. Company: Siemens Westinghouse Power Corp. Issued/Filed: March 21, 2007/Jan 20, 2000.

Thermal Barrier Coating Utilizing a Dispersion Strengthened Metallic Bond Coat. The present invention relates to an overlay coating that has improved strength properties. The overlay coating comprises a deposited layer of MCrAlY material containing discrete nitride particles therein. The nitride particles are present in a volume fraction in the range of 0.1-15.0% and have a particle size in the range of from 0.1 to 10.0 μm. The coating may also have oxide particles dispersed therein.

US 7166372: S. Bose, D.A. Bales, M.T. Ucasz, M.W. Wight, S.M. Burns, and T.E. Royal. Company: United Technologies Corp. Issued/Filed: Jan 23, 2007/ Aug 19, 2004.