EURO PM2023
CONGRESS & EXHIBITION

Technical Programme Committee
15th February 2023

ABSTRACTS BOOK – GROUP 7

APPLICATIONS

EPMA
european powder metallurgy association

EURO PM2023
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Technical Programme Committee
15th February 2023

APPLICATIONS

AEROSPACE

EPMA
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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235762322

Requested presentation type : Oral Presentation

Topic : Applications **Subtopic :** Aerospace

Author : Mr Aytar Umit (Turkish Aerospace, Turkey)

Co-author(s) : Mr Bayar Abdülcelil (Turkish Aerospace, Turkey), Prof Özerinç Sezer (METU, Turkey)

Title : Ti6Al4V Additive Manufacturing Powder Qualification And Reuse Methodology For Aerospace Application

Keyword(s) :
Additive Manufacturing; Ti6Al4V; Powder Reuse; Mechanical Properties; Selective Laser Melting; LPBF

Abstract :
This project aims to determine the reusability limits of the powders for L-PBF process through a series of productions and tests. In the project, 2 different powder sizes (15&45 and 20&63) were supplied.Each build will consist of 18 cylindrical bars with a diameter of 15 mm build in vertical orientation. The bar height will be 325 mm in the first run and will gradually decrease. Due to the nature of the reuse study, each cycle of production should be made on the exact same machine without interruption. That is, no other production should take place in the machine during the duration of this work. At the end of the project, powder qualification studies will be supported and limits will be determined for the alloy with reusability limits.

Innovative Aspect(s) :
The different powder sizes used and the relationship between reusability and fatigue life will be examined.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023 CONGRESS & EXHIBITION

01-04 October 2023

Paper Number : EP235762437

Requested presentation type : Oral Presentation

Topic : Applications **Subtopic :** Aerospace

Author : Dr Liu Yan (Simtec Soft Sweden AB, Sweden)

Co-author(s) : Dr Adolfsson Erik (Research Institutes of Sweden AB (RISE AB), Sweden), Dr Hosseini Seyed B. (Research Institutes of Sweden AB (RISE AB), Sweden), Mr Christoffersson Örjan (TurnTime Technologies AB, Sweden, Sweden), Dr Yan Zhenghua (Simtec Soft Sweden AB, Sweden)

Title : Simulation And Additive Manufacturing Of Complexly Designed Aircraft Component

Keyword(s) :
Cargo Handling Systems of Aircraft; Metal Binder Jetting; Sintering; CFD Simulation; Validation

Abstract :
An innovative component used for the cargo handling systems of Boeing 737 aircraft is developed to improve loaders' working conditions and protect cargo spaces, passenger luggage, and goods from damage. The design of the component makes it difficult to manufacture using conventional techniques, therefore metal binder jetting (MBJ), an additive manufacturing technique both faster and more cost-effective compared to the conventional laser|electron beam techniques is used.However, there is a risk of thermally induced distortion in connection with the post-process, specifically the sintering step. To address this, a 3D computational fluid dynamics (CFD) simulation model is developed and simulations are made to identify where and when unwanted distortions may occur during the sintering process. In the simulation, the sintering process follows an about 15 hours full sintering cycle with all the heating, holding, and cooling stages. The simulations are compared with experimental results to validate the simulations.

Innovative Aspect(s) :
Full-scale 3D CFD simulations of a full complete MBJ specimen sintering with all the heating, holding, and cooling stages will be presented.
To obtain a better understanding of the details of thermal gradients and gas flow during the sintering process.
This method allows 3D calculation of all the important processes including thermal gradients, gas flowing, thermal radiation, heat transfer, and conjugate heat conduction in solids so that the sintering processes of MBJ specimen can be well simulated, which can be used to optimize the sintering.
A complexly designed aircraft component can be manufactured through MBJ.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023 CONGRESS & EXHIBITION

01-04 October 2023

Paper Number : EP235765437

Requested presentation type : Oral Presentation

Topic : Applications **Subtopic :** Aerospace

Author : Dipl-Ing Mosler Susanne (Rolls-Royce Deutschland Ltd & Co KG, Germany)

Co-author(s) :

Title : Development Of 3D Screen Printing Technology For Oxidation Resistant High Temperature Alloy Sealing In Jet Engines

Keyword(s) :
3D Screen Printing; Sintering; Sealing; Aerospace; High Temperature Alloy

Abstract :
The aerospace industry has been relying on a limited range of options for air system sealing solutions and is now exploring improvement opportunities by using the 3D screen printing technology. As a sinter based metal powder process screen printing allows freedom in material choice as well as seal structure design. To achieve high sealing performance stringent requirements on uniformity and repeatability of component features have to be fulfilled. The influence of screen printing process parameters and sinter process parameters on material properties are investigated.

Innovative Aspect(s) :
3D screen printing technology is used for the first time to optimise an air sealing system in a jet engine. The screen printing process enables us to manufacture an alternative material with a specific porosity while also optimising the feature design of the seal. These options are not available for conventional honeycombs.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023

CONGRESS & EXHIBITION

Technical Programme Committee
15th February 2023

APPLICATIONS

AUTOMOTIVE

EPMA
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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235764215

Requested presentation type : Oral Presentation

Topic : Applications **Subtopic :** Automotive

Author : Dipl-Ing Walther Gunnar (Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM, Branch Lab Dresden, Germany)

Co-author(s) : Dr Ing Trapp Johannes (Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM, Branch Lab Dresden, Germany), Prof Dr Weißgärber Thomas (Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM, Branch Lab Dresden & Technische Universität Dresden, Faculty of Mechanical Engineering, Institute of Materials Science, Germany)

Title : Environmentally Friendly Sintered Friction Materials For Clutch And Brake Systems

Keyword(s) :
Aluminum Brake Disk; Sintered Brake Pads; Copper Free; Tribology; Iron-Based Friction Material

Abstract :
Sintered friction materials are used in particular for high performance applications due to their excellent temperature stability. Increasingly, new regulations regarding sustainability and environmental compatibility require innovative materials. In the USA, only brake pads with less than 0.5 percent may be sold by 2025 due to toxic abrasion. In addition, the new Euro 7 standard also imposes stricter limitations on non-exhaust particulate emissions.In this paper, material solutions for iron-based sintered linings for motorcycle brakes and synchronizer rings are discussed as an example of how to replace copper-based systems without losses in performance. Furthermore, the development of an aluminum composite brake disc is presented. These new brake discs use a particle-reinforced aluminum friction ring, which ensures an almost complete avoidance of the abrasion and, therefore, particle emission. Besides, the aluminum-based brake discs allow for lighter and more sustainable cars, e.g. by a 50 % reduction of the brake system's weight.

Innovative Aspect(s) :
Environmentally friendly materials
Cost efficient materials
Economical production process

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023

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Technical Programme Committee
15th February 2023

APPLICATIONS

BIOMEDICAL

EPMA
european powder metallurgy association

EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235735526

Requested presentation type : Oral Presentation

Topic : Applications **Subtopic :** Biomedical

Author : Dr Rossi Mariana (Federal University of São Carlos, Brazil)

Co-author(s) : Dr Kuroda Pedro, Prof Dr Afonso Conrado (Federal University of São Carlos, Brazil), Prof Dr Amigó Vicente (Universitat Politècnica de València, Spain)

Title : Difference On Organization And Geometry Parameters Of TiO2 Nanotubes In Different Beta Ti Alloys

Keyword(s) :
Beta Ti alloy; Surface modification; Anodization; Biocompatibility

Abstract :
Surface treatment of metallic materials can respond in different ways, based on it is chemical composition, phases and microstructure. In this work, four titanium alloys were coated by anodization process, to create a nanotube (Nt) layer to improve their corrosion and biological functions. The alloys presented different characteristics, being them: commercial pure Ti (c.p Ti), typical a phase; Ti-15Nb, a-prime + ß phases; Ti-34Nb-6Sn (ß metastable phase at room temperature); Ti-40Nb (ß stable at room temperature). The main difference among these alloys are the microstructure (grain size), chemical composition and phases. In this sense the characteristics of the Nts as well as the surface properties (roughness, contact angle, surface energy) will be investigated.

Innovative Aspect(s) :
This work can guarantee a greater success of these materials in the long term, by leading to adequate and faster osseointegration (in orthopedic field). In addition to these modifications, in the case of formation of NTs, they may be good candidates to carry key substances for tissue regeneration. It is noteworthy that there are few works reported in the literature on the formation of Nts on Ti-Nb(Zr,Sn) alloys and the correlation of the NTs properties and surface parameters.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235753753

Requested presentation type : Oral Presentation

Topic : Applications **Subtopic :** Biomedical

Author : Dr Ing Günther Anne (Fraunhofer IKTS, Germany)

Co-author(s) : Dipl-Ing Stelzer Sebastian, Ms Dudeck Anna (Fraunhofer IWU, Germany), Dipl-Ing Mannschatz Anne (Fraunhofer IKTS, Germany)

Title : Material And Process Hybridisation For Implant Materials - Laser Powder Bed Fusion (LPBF) Of Titanium Powders On In-mould Labelled Metallic Nonwovens In Injection Moulded Zirconia (CIM) Substrates

Keyword(s) :
Implantology, Medical Application; Titanium; LBPF; Zirconia; Injection Molding; Nonwoven; Steel; Composite; Interface; Damage-Tolerant; In-Mold Labelling

Abstract :
The research aims not only at the hybridisation of metal and ceramic structures via an innovative textile interface, but also at the hybridisation of conventional and additive powder technologies. In this way, multifunctional components with a geometric complexity are producible. One focus is on powder injection moulding in combination with in-mould labeling and LPBF. Composite components are bonded to each other by means of a metallic textile nonwoven. Due to the inherent properties of the nonwoven, like non-directional struture of the thin fibres and isotropic compressibility, it can partially embedded in the ceramic substrate and sintered without damaging the composite due to the different coefficents of thermal expansion (CTE) and shrinkage behaviour of ceramics and metals. For applications in implantology, in this case zirconia is bonded with titanium via LPBF by using a steel nonwoven to create the bond between the two materials and at the same time act damage-tolerant.

Innovative Aspect(s) :
The combination of different materials and processes is of great advantage for most areas of application in order to further optimize existing component properties and to be able to guarantee the increasingly complex requirements. In medical technology and especially in implantology, the materials zirconia and titanium are often used, as their biocompatible and mechanical properties are best suited for use in the human body. After titanium was successfully thoughened on alumina zirconia (ATZ) in the "Agent-3D" project cluster, the next goal was to minimize cracking in the ceramic during LPBF and to generate a damage-tolerant interface between the two materials. Industry-related projects have shown that a metallic nonwoven can withstand both, ceramic heat treatment and shrinkage and also energy input during LPBF, while protecting the composite from brittle fracture. In further work, one goal will be to replace the steel fibers with titanium to get better bonding effects.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235763609

Requested presentation type : Oral Presentation

Topic : Applications **Subtopic :** Biomedical

Author : Dipl-Ing Wolff Martin (Helmholtz-Zentrum Hereon, Germany)

Co-author(s) : Dr Nidadavolu Eshwara, Dipl-Ing Limberg Wolfgang, Dr Ebel Thomas, Prof Dr Willumeit-Roemer Regine (Helmholtz-Zentrum Hereon, Germany)

Title : Comparison Between MIM- And FGF-processed (3D-printing) Biodegradable Binary Mg-6.3Gd-Alloy

Keyword(s) :
MgGd; Biomaterial; Biodegradable; 3D-Printing; MIM; FGF

Abstract :
Recent research attests MgGd-alloys high suitability as biodegradable biomaterial due to its good strength, low stiffness and excellent biocompatibility. Moreover, novel investigations have proven that Mg-alloys can be successfully processed by binder based sintering technologies like MIM and Fused Granular Fabrication (FGF). While MIM intends to near net shape mass production, the latter one applies mainly to prototyping and production of individual patient specific implants; even with a scaffold-like strut structure inside of a dense shell.This study compares mechanical properties and microstructures of the binary alloy Mg-6.3Gd, processed by MIM and by FGF, respectively. It is shown that today's FGF technique achieves mechanical properties up to 215 MPa ultimate tensile strength (UTS) at 10% elongation at fracture, comparable to the MIM processed reference material. Both processes, MIM and FGF lead to the almost the same microstructure. Hence, novel FGF technique could overcome current challenges in 3D-printing of Mg-alloys.

Innovative Aspect(s) :
Recently, binder based 3D-printing technologies suffer from printing defects and delamination.Nowadays, this study pointed out that using Fused Granular Fabrication (FGF), the same mechanical properties and simular microstructure of biodegradable magnesium alloy Mg-6.3Gd were achieved than using Metal Injectiuon Molding (MIM).Worlwide first investigation about approching mechanical properties of biomedical material Mg-6.3Gd in comparison to the properties of MIM processed parts. The FGF technology enables fabrication of sophisticated shaped parts, obtaining inner hollow structure (eg. scaffold strut structure) and outside dense.Hence, patient adapted individual implants, obtaining material properties as MIM-produced, can be produced by binder based 3D-printing technology (FGF).

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235765805

Requested presentation type : Oral Presentation

Topic : Applications **Subtopic :** Biomedical

Author : Mr Tripathi Gaurav (Indian Institute of Technology Delhi, India)

Co-author(s) : Mr Tripathi Gaurav, Prof Pandey Pulak Mohan (Indian Institute of Technology Delhi, India)

Title : A Novel Route For Fabrication Of Iron--hydroxyapatite Biodegradable Implants Using Powder Metallurgy And Pressureless Microwave Sintering

Keyword(s) :
Bio-Implant; Bio-Degradable; CIP; Rapid Tooling; Additive Manufacturing

Abstract :
This work is intended to fabricate a biodegradable iron-hydroxyapatite (Fe-HAp) composite using rapid tooling and pressureless microwave sintering. Carbonyl iron particles (CIPs) and hydroxyapatite powder were mixed in a planetary ball mill to get a uniform mixture which was filled (under ultrasonic action) in molds made of a phosphate-based investment material. Many intricated and customized shapes can be produced using this rapid tooling process. Patterns for preparation of molds were made using stereolithography (SLA), which were later burnt out to get the cavity of same shape in which powder was filled and sintered successfully. Response surface methodology (RSM) was used to evaluate the effect of various sintering process parameters. Multi objective optimization of process parameters was done utilizing the approach of GA (genetic algorithm).

Innovative Aspect(s) :

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

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EURO PM2023
CONGRESS & EXHIBITION

Technical Programme Committee
15th February 2023

APPLICATIONS

ENERGY

EPMA
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EURO PM2023 CONGRESS & EXHIBITION

01-04 October 2023

Paper Number : EP235783264

Requested presentation type : Oral Presentation

Topic : Applications **Subtopic :** Energy

Author : Ms Monterde Gascón Mari Carmen (AMES PM Tech)

Co-author(s) : Dr Bernadet Lucile, Dr Torrell Faro Marc (IREC, Spain), Dr Calero Martinez Jose Antonio (AMES PM Tech, Spain), Dr Jimenez-Piqué Emilio (Universitat Politecnica de Catalunya - EEBE, Spain)

Title : Roll Painting Deposition Of MnCo2O4 Coating On SUS445 Interconnects Manufactured By Powder Metallurgy:electrochemical Test In SOFC Mode And Degradation Test After 800h In SOEC Mode

Keyword(s) :
Solid Oxide Cell System; Interconnects; Barrier Layer; Coating; Manganese Cobalt Oxide Spinel; Ferritic Stainless Steel

Abstract :
Manganese cobalt oxide spinel ink applied by roll painting on SUS445 steel interconnects are promising protective coating materials as a barrier layer for volatile chromium species. To achieve high density, these coatings are often sintered in two stages, involving heat treatment in reducing and oxidizing atmospheres. This work shows the design, development and optimization of a functional metal interconnect fabricated by conventional powder metallurgy for solid oxide systems. The efficiency of the obtained coated interconnect is evaluated by single repeat unit electrochemical tests and post-mortem analysis. The polarization curve obtained in solid oxide cell mode at 800°C shows a current density around 0.9 A|cm2. The degradation results below 1%|Kh after 800h at 800°C under 10A working in solid oxide electrolysis mode show an efficient barrier layer coating to volatile chromium species. The obtained results show the efficiency of the coating process and the functionality of the designed interconnector.

Innovative Aspect(s) :
The obtained results indicated that ferritic stainless steel interconnect manufactured by powder metallurgy with simply mix of powder and with a lower content in chromium are a potential alternative to be considered in solid oxide systems. Effectiveness and efficiency of MnCo2O4 coating apliyed by roll painting like a barrier layer for volatile chromium species at 800°C in SOFC and SOEC mode. Development, design, construction and validation of a demonstrator for the measurement of high temperature solid oxide electrolyzer systems.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023 CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235762125

Requested presentation type : Oral Presentation

Topic : Applications **Subtopic :** Energy

Author : Dr Sun Jinhua (Chalmers University of Technology, Sweden)

Co-author(s) : Dr Sun Jinhua, Dr Sun Jinhua (Chalmers University of Technology, Sweden)

Title : Coating Different Graphene Derivatives On Cathode Powders For Lithium-ion Battery With Improved Performance

Keyword(s) :
Graphene; Coating; Cathode; Powder; Lithium Ion Battery

Abstract :
Efficient strategy to increase the electrical conductivity of cathode is highly desirable for achieving high-performance lithium-ion battery (LIB). Here, we developed a universal method to controllably coat different graphene derivatives (e.g., graphene oxide (GO), reduced graphene oxide (RGO), and graphite nanoplatelet) on both commercial lithium iron phosphate and Lithium nickel manganese cobalt oxides-based powders and investigate the corresponding electrochemical performance for LIB. Benefiting from such industrial adaptable strategy, the graphene derivatives are uniformly coated on cathode materials (loading up to 8 wt%) in large scale without aggregation. The effect of three different graphene derivatives on the performance of cathode was systematically investigated, and the most favorable graphene derivatives was selected and recommended for the industrial partner with the consideration of balancing the performance, cost, availability, and processability. This study provided a fundamental understanding of different graphene derivatives as conformally coated conductive materials on the performance of LIBs.

Innovative Aspect(s) :

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235763996

Requested presentation type : Oral Presentation

Topic : Applications **Subtopic :** Energy

Author : Mr Lindroos Tomi (VTT, Finland)

Co-author(s) : Dr Pippuri-Mäkeläinen Jenni, Ms Manninen Aino, Dipl-Ing Riipinen Tuomas, Dr Metsä-Kortelainen Sini, Mr Antikainen Atte, Mr Kinos Timo (VTT, Finland)

Title : Additive Manufacturing Of Permanent Magnet Assisted Electric Motor Components

Keyword(s) :
Soft Magnetic; Additive Manufacturing; Powder; Electrification; Electric Motor

Abstract :
Green electrification is vital for the society's decarbonisation. This sets a strong pressure on manufacturers of electrical machines to produce items of higher efficiency and, simultaneously, prepare oneself for forecasted supply risks of raw materials. Additive Manufacturing is seen as enabler to produce components for novel electrical machine architectures with performance and designs unattainable with conventional manufacturing. In this study, a permanent magnet (PM) assisted synchronous reluctance motor based on laser powder bed fusion (L-PBF) is introduced. Production of soft magnetic powder tailored for L-PBF and optimization of process parameters and further post treatments to achieve goods magnetic properties are shown. Characterized magnetic properties are used as input values for motor design where both performance and possibilities of L-PBF are used as design criteria. Permanent Magnet electric motor of the e-scooter is used as reference. The results show that optimized architectures provide high performance with lower PM content.

Innovative Aspect(s) :
Tailored soft magnetic powder for L-PBF introducedDesign and manufacturing route for permanent magnet assisted synchronous reluctance motor is introduced. Results are compared against commercial permanent magnet electric motor of e-scooter. By utilization freedom of design provided by AM high performance motor with remarkably lower permanent magnet content can be realized.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

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EURO PM2023 CONGRESS & EXHIBITION

01-04 October 2023

Paper Number : EP235765639

Requested presentation type : Oral Presentation

Topic : Applications **Subtopic :** Energy

Author : Dr Ing Andersen Olaf (Fraunhofer IFAM Dresden, Germany)

Co-author(s) :

Title : Development Of 316L Sinter Paper For Application As Gas Diffusion Layer In PEM Fuel Cells

Keyword(s) :
Sinter Paper; 316L; PEM Fuel Cell; GDL; Porous Metal

Abstract :
Using processes derived from paper technology, organic fibers, fillers and additives can be mixed with metal powder to produce a flat product. In a subsequent heat treatment, the organic components are removed, leaving a purely metallic porous material, the so-called sinter paper. This approach is used for the development of an innovative Gas Diffusion Layer (GDL) for mobile fuel cells. GDLs are arranged between the bipolar plate and the electrode in fuel cell stacks. They ensure optimal gas distribution as well as the removal of water, heat and electricity.So far, metallic sinter paper that meets the materials specification of stainless steel 316L could be made. The thickness of the paper was reduced down to 200 µm, and the porosity of the base material reaches values around 60 %. A thorough morphological characterization was carried out based on high-resolution µCT scans and their analysis via the software package GeoDict.

Innovative Aspect(s) :
Standard material is currently based on graphite.Novel performance properties are expected.A new sintered product with mass production capability.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

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EURO PM2023
CONGRESS & EXHIBITION

Technical Programme Committee
15th February 2023

APPLICATIONS

OTHER APPLICATIONS OF PM

EPMA
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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235764058

Requested presentation type : Oral Presentation

Topic : Applications **Subtopic :** Other Applications of PM

Author : Dr Ing Leitz Karl-Heinz (Plansee SE, Austria)

Co-author(s) : Dr Ing Valentini Bernhard (PlanseeSE, Austria)

Title : Energy Efficient Thermo-fluid Dynamically Optimized High Temperature Vacuum Furnaces For Heat Treatment

Keyword(s) :
Energy Efficiency; High Temperature Vacuum Furnace; Fast Cooling; Refractory Metals; Simulation

Abstract :
High temperature vacuum furnaces for heat treatment typically have operation powers of several hundred kilowatts. They are generally equipped with a fast cooling system that has to assure that cooling rates, required for certain heat treatment processes, are uniformly met in the whole load. In this contribution thermo-fluid dynamic models of a high temperature vacuum furnace with a refractory metal hotzone are applied to show potentials for energy savings without losing cooling efficiency. The simulation results are validated by experimental data. The results show that an optimization of the gas system in combination with new design concepts allows significant energy savings.

Innovative Aspect(s) :

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235764202

Requested presentation type : Oral Presentation

Topic : Applications **Subtopic :** Other Applications of PM

Author : Mr Resendes Tomás (CEMMPRE - University of Coimbra, Portugal)

Co-author(s) : Prof Dr Vieira Teresa, Dr Rodrigues Patrícia (CEMMPRE - University of Coimbra, Portugal)

Title : Shape Memory Alloy Strain Sensor Integrated In Structural 3D Object During Additive Manufacturing

Keyword(s) :

Abstract :

The additive manufacturing process lets freedom to explore new ways to make several complex geometries of 3D objects. However, these can be critical to the mechanical behavior during the structural application. Maintaining the stress field inside the component within the safe values previously evaluated from the design is essential to prevent its premature failure. This study aims to promote a precise measurement of the deformation through a strain sensor integrated into the 3D object close to critical zones. The NiTi shape memory alloy could promote high-precision measurements of sensors. The superelasticity of this alloy enables a linear relationship between the deformation and the resistivity. Therefore, this solution allows taking advantage of superelasticity to evaluate close to the critical zones deformation of 3D objects with high precision during their lifetime. The present study highlights the role of inside strain sensors embedded during AM and compares them with conventional measurements.

Innovative Aspect(s) :

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

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EURO PM2023 CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235765498

Requested presentation type : Oral Presentation

Topic : Applications **Subtopic :** Other Applications of PM

Author : Mr Ozates Cem (Sentes-BIR R&D Center, Turkey)

Co-author(s) : Dr Ertugrul Onur (Izmir Katip Celebi University, Turkey), Mr Genc Bulent (Sentes-BIR R&D Center, Turkey)

Title : Influence Of Powder Oxygen Level And Particle Size On The Properties Of Copper Binder Jetting Parts

Keyword(s) :
Additive Manufacturing; Binder Jetting; Copper; Particle Size

Abstract :
Binder jetting has advantages such as multiple production and low processing costs. In this study, effects of particle size distribution (15-45 and 10-63 µm) and oxygen content of the copper powders on the density and mechanical properties of the final part are investigated. In addition, sintering optimization with various sintering regime and atmosphere is studied. As a result, it is seen that 1070°C and 100% H2 are required for sintering. Also, the best results of tensile tests are obtained with low oxygen (LO) content of 15–45 µm particle size copper powders. According to Archimedes tests, lower oxygen content 10-63 powder resulted in higher density compared to LO 15-45 powder. However, according to the image analysis, 15–45 µm particle size has better densification, and the internal porosities were much smaller in the structure. The surface roughness differs among the two powders as 10-63 particle size results.

Innovative Aspect(s) :
Copper is among the most conductive metallic materials. Its electrical and thermal conductivity is second only to silver. For most metals, 3D printing is mostly done by laser or electron beam powder bed fusion processes. Due to copper's high reflectivity and very good thermal and electrical conductivity, it becomes very difficult to print 3D parts with powder bed fusion methods. Binder jetting has a high potential for use in order to eliminate these problems of copper.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

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EURO PM2023

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15th February 2023

APPLICATIONS

TOOLING

EPMA
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EURO PM2023 CONGRESS & EXHIBITION

01-04 October 2023

Paper Number : EP235763604

Requested presentation type : Oral Presentation

Topic : Applications **Subtopic :** Tooling

Author : Dr Ing Schmid Dominik (Kennametal Shared Services GmbH, Germany)

Co-author(s) : Dr Prichard Paul (Kennametal Inc., USA)

Title : Challenges And Solutions In The Additive Manufacturing Of Metal Cutting Tools

Keyword(s) :
Cemented Tungsten Carbide; Hot Work Tool Steel; Binder Jet Printing; Laser Powder Bed Fusion; Metal Cutting

Abstract :
Additive manufacturing provides new opportunities for cutting tools to provide geometric freedom to enhance functionality and performance. The challenge in realizing the full potential is multifarious: the additive processes need to match the material quality of existing processes while creating these complex geometries. At the same time the engineered tool designs have to make use of the geometric freedom to exceed the capabilities of conventional tools. This work will highlight some challenges and solutions in processing cemented tungsten carbide as well as hot work tool steel. The presentation will also discuss opportunities with respect to tool design and show examples of innovative structures.

Innovative Aspect(s) :
Processing of cemented carbide by additive manufacturing (binder jet printing).
Additive manufacturing of hot work tool steel (laser powder bed fusion).
Innovative approches in metal cutting tool design-Industrialized applications.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235764696

Requested presentation type : Oral Presentation

Topic : Applications **Subtopic :** Tooling

Author : Dr Bezuidenhout Martin (Stellenbosch University, South Africa)

Co-author(s) : Dr Wartbichler Reinhold, Dr Tarragó José, Ms Beltz de Arancibia Christa, Dr Moseley Steven (Hilti AG, Liechtenstein), Prof Sacks Natasha (Stellenbosch University, South Africa)

Title : Wear Observations Of Cemented Carbide Tips In Reciprocating Sawing Of Structural Steel

Keyword(s) :
Reciprocating Sawing; Cemented Carbide; Wear; Construction

Abstract :
The performance of different hardmetal cutting tip grades were investigated in this study for handheld powered reciprocating sawing of structural steel. Variants consisted of fine-grained WC with 12 wt% Co binder and medium-grained WC with 8 wt% Co binder content. The latter was tested with and without a PVD AlTiN-based coating. Microscopy techniques were applied to analyse the wear according to the performance indicators of an industry relevant application case. Early fractures were dominant on all blades with uncoated tips. Contextually, this was not considered as traditional catastrophic failure since blades remained operational until tips were near to or completely removed. Fractures were delayed on coated tips with fatigue indicators observed in the microstructure. Based on the main tool life limiting wear observations, critical areas are discussed which, when addressed during cutting tip manufacturing, would be expected to enhance the on-site performance of the tools.

Innovative Aspect(s) :

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235765264

Requested presentation type : Oral Presentation

Topic : Applications **Subtopic :** Tooling

Author : Dr Ing Deirmina Faraz (Sandvik Additive Manufacturing, Sweden)

Co-author(s) : Mr Quarzago Lorenzo, Prof Pellizzari Massimo (University of Trento, Italy), Dr Ing Bettini Eleonora (Sandvik Additive Manufacturing, Sweden), Ing Ritche Matthew, Ing Butcher Daniel, Prof Mehraban Shahin, Prof Lavery Nicholas (Swansea University, United Kingdom)

Title : Hot Work Tool Steel Tailored For The Laser Powder Bed Fusion Processing

Keyword(s) :
Hot Work Tool Steel; Alloy Design; Tempering; Thermal Fatigue; Additive Manufacturing

Abstract :
Hot work tool steels with medium C contents are known to be difficult to process by laser powder bed fusion (L-PBF). Cold and, to a lesser extent, hot cracking occur in these alloys. Cold cracks are attributed to the low ductility and large residual stresses due to the complex thermal profiles. These can be avoided by platform preheating, which may introduce additional costs and side-effects on microstructure and properties. Therefore, the market trend is to develop new steel grades with improved 3D-printabilty. In this work, a prototype alloy with a leaner C content is proposed. To compensate for the negative effect of reduced C, computational thermodynamics was used to define chemistries with an optimized balance of carbide forming elements, and Si. The prototype tool steel shows enhanced L-PBF processability, and properties meeting and|or exceeding those of wrought AISI H13 in terms of hot strength, tempering and thermal fatigue resistance.

Innovative Aspect(s) :
By the aid of cost efficient computational thermodynamics a novel hot work tool steel has been designed to meet both requirements for laser powder bed fusion processability and service application performance.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235765795

Requested presentation type : Oral Presentation

Topic : Applications **Subtopic :** Tooling

Author : Mr Arya Shitanshu (Indian Institute of Technology Delhi, India)

Co-author(s) : Prof Pandey Pulak Mohan (Indian Institute of Technology Delhi, India)

Title : Parametric Optimization Of Sintering Parameters For Fabrication Of Tool For Electrical Discharge Machining

Keyword(s) :
Rapid Tooling; Microwave Sintering; Genetic Algorithm

Abstract :
The present work focuses on fabricating a complex shape copper tool for electric discharge machining application through a novel route that employs rapid tooling and pressureless microwave sintering. The combination of experiments was obtained using central composite design (CCD) technique for three different process parameters namely sintering temperature, holding time and heating rate associated with the sintering machine used. The response in the form of sintered density, shrinkage and electrical conductivity was studied. To obtain the optimal parameters for maximum electrical conductivity of the tool, multi-objective optimization was done using genetic algorithm. Further addition of graphene was done successfully to improve the electrical conductivity of tool which resulted in better performance of tool.

Innovative Aspect(s) :

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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