EURO PM2024 CONGRESS & EXHIBITION

Technical Programme Committee
8th of February 2024

ABSTRACTS BOOK

MATERIALS

EPMA
european powder metallurgy association

EURO PM2024 CONGRESS & EXHIBITION

Technical Programme Committee
8th of February 2024

MATERIALS

HARD METALS AND CERMETS

EPMA
european powder metallurgy association

EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M01
ID : 6278470

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Hard Metals & Cermets

Author : Dr Kok Yin Nan (Powderloop Technology Ltd., United Kingdom)

Co-author(s) :

Title : Resource Efficient Hardmetal Powder For Additive Manufacturing (AM)

Keyword(s) :
Hardmetal Powder, Additive Manufacturing, DED, Hardfacing, Coating, Powder Manufacturing,Tungsten Carbide, Resource Efficient

Abstract :
Hardmetal powders used in today's AM were originally formulated for thermal spraying over six decades ago. The conventional hardmetal powder manufacturing process involved multiple high-energy stages i.e. pre-manufacturing of carbide and grinding. During AM process, a melt pool is created by laser beam. Chemical reactions occur within the melt pool in a fraction of a second. When pre-manufactured carbide is used, the carbide is re-melted, this can lead to decomposition and formation of unfavourable brittle eta-carbide phase which is detrimental to the coating performance. This paper presents a novel powder for AM using a resource-efficient powder manufacturing method. The powder was produced by employing elemental materials compared to the conventional methods that used pre-manufactured carbide powder. This novel powder is expected to promote in-situ formation of carbide during laser fusion processes and provide a chemically more stable coating and cleaner interface with better adhesion between the carbide and the matrix.

Innovative Aspect(s) :
This paper has not been submitted elsewhere. This work is based on our internal research and developments and findings from our subject matter expertise in the field. As explained in the abstract, as far as we are aware, there is no commercially available powder as such for AM to promote in-situ formation of hard carbides using the resource-efficient methods of spray drying.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M02
ID : 6278433

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Hard Metals & Cermets

Author : Ing Biedma Ángel (Universidad Carlos III de Madrid, Spain)

Co-author(s) : Mr García Marcos (Universidad Carlos III de Madrid, Spain); Dr de Nicolás María (IMDEA Materiales, Spain); Prof Dr Gordo Elena (Universidad Carlos III de Madrid, Spain)

Title : Influence Of Sintering Pressure Cycle And Composition On The Processing Of Ti(C,N)-based Cermets

Keyword(s) :
Ti(C,N)-based Cermets, Sintering Cycle, Sintering Vacuum Pressure, Microstructure Formation, Densification

Abstract :
Ti(C,N) cermets with Fe-based binders have shown great potential as alternatives to hardmetals, as they can reduce the dependence on critical raw materials while maintaining similar properties. Although Ti(C,N)-FeNiCr has been extensively researched, there are certain aspects that warrant further investigation in order to enhance its properties. This study focuses on the development of sintering combined cycles, which involve controlling the levels of vacuum and gas partial pressures. These cycles aim to address various challenges, such as the degassing of N2 from ceramic particles, the volatilization of metallic binder, grain growth, and densification. The formation of gradients and oxides on the surface of cermets has also been examined. Furthermore, adjustments to the levels of Cr and C have been made to prevent the precipitation of M7C3-type carbides. The CALPHAD methodology and EBSD have been utilized within the framework of this study to analyze and understand the cermet's behavior.

Innovative Aspect(s) :
This project enhances the comprehension and knoledge of the sintering conditions of cermets, thereby making a valuable contribution. Its primary objective is to tackle existing challenges in vacuum sintering process and provide explanations for the occurrence of such issues in this particular Ti(C,N)-based cermets.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M03
ID : 6278565

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic : Hard Metals & Cermets**

Author : Dr De Gaudenzi Gian Pietro (F.I.L.M.S. S.p.A., Italy)

Co-author(s) : Mrs Tedeschi Sandra (F.I.L.M.S. S.p.A., Italy); Mrs Pirone Fransisca (F.I.L.M.S. S.p.A., Italy); Ing Garabelli Mattia (F.I.L.M.S. S.p.A., Italy); Mr Ruggiero Domenico (F.I.L.M.S. S.p.A., Italy)

Title : Functionally Graded Hardmetal Systems For Applications Requiring Corrosion And Abrasion Resistance

Keyword(s) :
Functionally Graded Hardmetal, Functionally Graded Metallic Binder, Corrosion Behavior, Mechanical Properties

Abstract :
The application of the Functionally Graded Materials concept to cubic carbide-free hardmetals is commonly associated with achieving optimized mechanical properties in different regions of an article. In this work, special attention is given to maximize the corrosion and wear resistance of an outer layer while keeping the toughness values of the bulk material. This involves a detailed examination of gradients in the alloying of the metallic binder. A Ni-based outer layer, featuring a composition known for corrosion resistance, is sintered over a Co-based bulk with a medium WC grain size distribution. The concentration gradients of Ni and Co, along with the influence on mechanical properties and corrosion resistance, are thoroughly assessed. This analysis extends to the effects of additives such as chromium, molybdenum, with copper considered as an additional additive. The results reveal a promising path for the development of innovative hardmetal solutions in demanding applications.

Innovative Aspect(s) :
The application of the Functionally Graded Materials (FGM) concept to the hardmetal Metallic Binder (MB). Investigation on the impact of MB compositional gradient on mechanical properties and corrosion behavior in FGM systems. Exploring additive diffusion and the effect of additive content gradient on mechanical properties and corrosion behavior. The role of copper in the MB alloy on the corrosion behavior of hardmetal in simulated sea water.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M04
ID : 6277058

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Hard Metals & Cermets

Author : Dr Nilen Roger (Element Six (UK) Ltd., Global Innovation Centre, United Kingdom)

Co-author(s) : Dr Konyashin Igor (Element Six GmbH, Germany); Dr Balmer Richard (Element Six (UK) Ltd., Global Innovation Centre, United Kingdom); Mr Nicolaides Thomas (Element Six (UK) Ltd., Global Innovation Centre, United Kingdom); Mr Ries Bernd (Element Six GmbH, Germany); Mr Walsh Matthew (Element Six (UK) Ltd., Global Innovation Centre, United Kingdom)

Title : Polycrystalline Diamond Cutters With Cobalt-Rhenium Binder For Enhanced Thermal Stability In Rock Drilling

Keyword(s) :
Cobalt Rhenium Carbide Polycrystalline Diamond Rock Drilling

Abstract :
The excellent abrasion resistance and impact resistance of polycrystalline diamond (PCD) make it the material of choice for rock cutting applications. For example, a PCD table bonded to a WC|Co substrate forms a cutter suitable for oil and gas drilling. However, the presence of binder in the PCD – infiltrated from the substrate during high pressure high temperature (HPHT) sintering – severely shortens tool life through thermal degradation mechanisms. Acid leaching this binder from the cutting surface significantly improves its thermal stability, but the use of alternative, more thermally stable binders is also an option. In this work, a novel Co-Re binder was evaluated for thermally stable PCD. Hot-stage XRD confirmed a 200°C delay to the onset of graphitisation in the PCD compared to standard Co binder-based PCD, and high-resolution TEM confirmed Re-enrichment at the binder-diamond interface. Finally, crack analysis demonstrated the material's suitability for thermally demanding drilling applications.

Innovative Aspect(s) :
The sintering of a Co-Re based carbide grade, and its application in polycrystalline diamond (PCD) cutting tool manufacture for oil & gas drilling applicationsDemonstrated gain in thermally stability of Co-Re binder-based PCD as measured by hot-stage XRD via the delayed onset (at least 200°C) of diamond graphitisation compared to standard Co binder-based PCDThermal stability gain also demonstrated in crack inspection comparison between Co-Re and Co-based PCD polished cross-sections after thermal treatments up to 10000C (for 1 hour) under vacuumHigh-resolution TEM & EDX evidence for the build-up of several Re-rich atomic monolayers at the diamond – binder interface, to which the thermal stability improvement is partly attributedCredible performance of the resulting novel PCD in granite cutting tests using a vertical turret lathe (pin-on-disc type abrasion test).

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M05
ID : 6278304

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Hard Metals & Cermets

Author : Dr Ing Mégret Alexandre (University of Mons, Belgium)

Co-author(s) : Prof Dr Vitry Véronique (University of Mons, Belgium); Prof Dr Delaunois Fabienne (University of Mons, Belgium)

Title : Corrosion And Tribological Characterizations Of A Recycled Tungsten Carbide Powder

Keyword(s) :
Cemented Carbide, Recycled Powder, Corrosion Properties, Tribology

Abstract :
Recycling end-of-life tungsten carbide tools is important to encounter the issues linked to critical raw materials (CRM). Indeed, cobalt and tungsten have been listed as critical by the European Commission since 2011. Previous studies have characterized a recycled powder in terms of densification, microstructure, and mechanical properties, leading to interesting properties compared to conventional powders. The study of corrosion and tribological properties was not characterized although they are essential to understand the interactions between the cemented carbide tool and other materials. In this study, parts made from recycled tungsten carbide powder containing 7.5 wt.% cobalt have been sintered to evaluate their corrosion properties (open-circuit potential, polarizations…) and their tribological properties (friction coefficient, wear mechanisms…).

Innovative Aspect(s) :
The study of corrosion and tribology of cemented carbide parts is not numerous but is of great importance for their traditional applications. Correlations with microstructures and mechanical properties are drawn. Moreover, only few papers mention the characterization of recycled powder.

Reviewer's name : ……

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : ……

Notes to author : ……

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M06
ID : 6278305

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Hard Metals & Cermets

Author : Mr von Spalden Mathias (Fraunhofer IKTS, Germany)

Co-author(s) : Dipl-Ing Vornberger Anne (Fraunhofer IKTS, Germany); Dr Ing Pötschke Johannes (Fraunhofer IKTS, Germany)

Title : Influence Of Various Alloying Elements On WC-Ni Hardmetals

Keyword(s) :
Hardmetal, WC, FAST, SPS, Co Free, Alternative Binder Systems

Abstract :
The substitution of cobalt in hardmetals has a crucial economic role, since increasing costs driven by the demand for Li-ion batteries can lead to higher prices for the majority of hardmetal grades which depend on cobalt as binder metal. Nickel has already proven to be a possible substitute. However, so far it cannot compete with cobalt in terms of mechanical properties. Therefore, in this work a systematic investigation on various alloying elements in nickel-based binder systems for hardmetals was done. A further goal of this study was the reduction of needed sintering temperatures which can lead to less energy consumption for the sintering process. The trials were carried out by using field assisted sintering. Subsequent SinterHIP treatment was done to investigate quasi thermodynamically stable states. The chosen alloying elements are iron, manganese, copper, silicon, and germanium. For some combinations, hardmetals with a novel nickel-based binder alloy could be successfully prepared.

Innovative Aspect(s) :
To the authors' knowledge there have not been any systematic studies on alloying nickel in situ with various elements as binder systems for hardmetals in combination with the preparation by a field assisted sintering technique.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M07
ID : 6277229

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Hard Metals & Cermets

Author : Dr Sandoval Ravotti Daniela (Hyperion Materials & Technologies, Spain)

Co-author(s) : Dr Girman Valdimír (Institute of Materials Research, Slovak Academy of Sciences, Slovakia); Dr Sedlak Richard (Institute of Materials Research, Slovak Academy of Sciences, Slovakia); Ing Serra Marc (Universitat Politècnica de Catalunya, Spain); Dr Larrimbe Laura (Hyperion Materials & Technologies, Spain); Ing Mendez Marco (Hyperion Materials & Technologies, Spain)

Title : Influence Of Processing Route In The Fracture Toughness Of Cemented Carbides With Different Grain Size And Binder Content

Keyword(s) :
WC-Co, Fracture Toughness, WC Plasticity, TEM, Dislocations

Abstract :
Samples with 12 and 20 wt.% of binder content and fine, medium, and coarse WC grain size were manufactured by three different processing routes. It was noticed that for one route, fracture toughness was improved without a decrease in hardness, contrary to the other routes in which the typical hardness and toughness inverse relation was followed. As expected for cemented carbides, different mechanisms compete to affect fracture toughness. On one end, for fine grain size, the toughness is influenced mainly by the binder content; on the other end of the scale, for coarse grain size, binder content has a minimum influence, regardless of the processing route. Unexpectedly, deeper characterization by EBSD, XRD and TEM showed that there is a region of binder and grain size in which the processing route leads to an improved intrinsic plasticity of WC and ultimately, the fracture toughness of the composite.

Innovative Aspect(s) :
By changing the processing route, and for a range of binder content and WC grain size, the plasticity of the WC is afected, resulting in a improved fracture toughness of the composite

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M08
ID : 6280791

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic : Hard Metals & Cermets**

Author : Ms Mohammadpour Kasehgari Saba (KTH Royal Institute of Technology, Sweden)

Co-author(s) : Ms Toller-Nordström Lisa (KTH Royal Institute of Technology, Sweden); Ms Borgenstam Annika (KTH Royal Institute of Technology, Sweden)

Title : Martensitic Phase Transformation In Cemented Carbides With Steel-Based Binder

Keyword(s) :
Cemented Carbides, Alternative Binders, Advanced High-Strength Steel, Martensitic Transformation, Thermodynamic Modeling, Electron Backscatter Diffraction

Abstract :
Cemented carbides, important composites produced by powder metallurgy, exhibit an excellent performance within metal cutting tools and mining equipment when their hard phase, tungsten carbide, is bound by cobalt. However, in recent years, due to health and ethical concerns related to cobalt, there has been a significant focus on designing alternative binders. The martensitic transformation in high-strength steel and its subsequent transformation-induced plasticity effect propose a solution to substitute cobalt and improve the overall properties of cemented carbides. However, numerous factors including carbon and tungsten content, residual stresses induced by tungsten carbide grains, and the confined dislocation mean free path in the binder significantly affect the nature of the martensitic transformation in these composites. Thus, in this study, thermodynamic and kinetic-based models coupled with dilatometry and electron backscatter diffraction characterization were utilized to predict the martensitic start temperature and fraction and morphology of martensite in steel-based binders of cemented carbides.

Innovative Aspect(s) :
Over time, we have gained extensive knowledge and valuable insights about the third generation of steel. Despite numerous previous studies on alternative binders in cemented carbides, there has been no attempt before to apply the latest achievements in advanced high-strength steel to these relatively new metal composites. The current work has aimed to build a multi-length scale computational framework for designing new sustainable composites with minimum trial and error experiments. Thermodynamic and kinetic-based models coupled with experimental data were utilized for a thorough understanding of phase transformations and microstructural evolution in cemented carbides with the aim of translating the martensitic phase transformation and the TRIP effect to the binders in these composites. The models will further be used to explore different processing conditions and sets of compositions for tailoring phase transformations in steel-based binders in cemented carbides which would lead to improved strength and ductility and reduced usage of cobalt.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M09
ID : 6281171

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Hard Metals & Cermets

Author : Prof Dr Araya Nicolás (Universidad de Concepción, Chile)

Co-author(s) : Ing Sauceda Sergio (Universidad de Concepción, Chile); Ing Oropesa Yovany (Universidad de Concepción, Chile); Dr Maril Marisol (Universidad de Concepción, Chile); Miss Contreras Javiera (Universidad de Concepción, Chile)

Title : Comparative Study Of Densification Of Fe-SiC Cermet Through Press And Sinter And Hot-pressing

Keyword(s) :
CERMETS, Sintering Techniques, Abrasive Wear

Abstract :
In CERMET material development, Co and W, due to their high cost and limited access, result in high cost and enviromental issues. Seeking a cost-effective alternative, the Fe-SiC system was explored, showing potential for developing wear resistant CERMETS. This study compared Fe-SiC CERMET produced via conventional sintering (CS) and Hot Pressing (HP). Samples with 50, 70 and 90 wt.% SiC were produced, but due to densification problems, the 90 WT.% SiC condition was quickly discarded. CS utilizing 5% PVA a binder faces densification challenges. To address this, 0.2% graphite was added, enhancing densification up to 80% but compromising mechanical properties at 1100°C. SEM analysis confirmed proper Fe dispersion around SiC particles and the formation of sintering necks, however CS lacked time for complete consolidation. On the other hand, hot-pressed samples were able to reach more than 90% densification. Microstructural and mechanical analysis show promising results for applications involving abrasive-wear resistance.

Innovative Aspect(s) :
CERMET production using Fe-SiC has been almost not explored. Somo authors have used this system to produce self-lubricating steel with up to 5 wt.% SiC and other author have sintered Fe with milimetric SiC particles for cutting tool applications but have not reached more than 75% densification. This study used 50, 100 and 150 microns SiC particles in order to develop a material with higher density an suited for abrasive wear applications.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M10
ID : 6280715

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Hard Metals & Cermets

Author : Mrs Fooladimahani Saghar (Universitat Politècnica de Catalunya - BarcelonaTech, Spain)

Co-author(s) : Dr Liu Chao (Xiamen Tungsten Co., Ltd., China); Dr Liu Bolu (Xiamen Tungsten Co., Ltd., China); Dr Lin Le (Xiamen Tungsten Co., Ltd., China); Prof Llanes Luis (Universitat Politècnica de Catalunya - BarcelonaTech, Spain)

Title : Optimization Of Short-pulse Laser Shaping Of Micro-features In Cemented Carbides: Assessment Of Dimensional Accuracy, Surface Integrity And Microstructural Effects

Keyword(s) :
Laser Ablation Method, Controlled Damage, Hardmetals, Mechanical Properties

Abstract :
Laser ablation is a proven method for post-processing fabrication, surface texturing, and micromachining hardmetal tools. In this regard, dimensional accuracy and surface integrity of shaped features are expected to depend on both processing parameters and microstructural assemblage. However, detailed information about such correlations is limited, especially concerning practical and cost-effective methods like short-pulse laser ablation. This study addresses this gap by shaping microfeatures on the surfaces of fine-grained cemented carbides with different Co content. In doing so, distinct laser processing parameters are optimized to shape microdimples, micronotches, and through-thickness microgrooves accurately. Advanced characterization techniques, including scanning electron microscopy, focused-ion beam milling, and digital image correlation, are employed to investigate the surface integrity of these features. Results show that laser parameter alterations significantly influence surface integrity (concerning induced damage or residual stresses). Feasible application of this knowledge is applied to evaluate the fracture toughness and damage tolerance behavior of cemented carbides.

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 PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M11
ID : 6278541

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic : Hard Metals & Cermets**

Author : Mr Quinzin François (Univ. Lille, CNRS, INRA, ENSCL, UMR 8207 - UMET - Unité Matériaux et Transformations, F-59000 Lille, France, France)

Co-author(s) : Dr Beclin Franck (Univ. Lille, CNRS, INRA, ENSCL, UMR 827 - UMET - Unité Matériaux et Transformations); Dr Touzin Matthieu (Univ. Lille, CNRS, INRA, ENSCL, UMR 827 - UMET - Unité Matériaux et Transformations); Dr Cordier Catherine (Univ. Lille, CNRS, INRA, ENSCL, UMR 827 - UMET - Unité Matériaux et Transformations)

Title : HEA Matrix Composites Processed Via Hot Press Sintering

Keyword(s) :
High Entropy Alloy, Metal Matrix Composite, Reaction Sintering, Hot Press Sintering

Abstract :
The AlCrFeMnMo HEA shows high hardness properties. In order to further improve its hardness, an AlCrFeMnMo HEA matrix composite has been fabricated by hot press sintering of a mixture of pure metallic elements and reinforcements powders. During the sintering process, the metallic powders react and form, through diffusion, the homogeneous BCC HEA matrix. This original method allows for faster processing of composite materials without requiring pre-alloying, thus bringing time and energy gains. Different sintering conditions and post-sintering thermal treatments were carried out. Different reinforcements were studied such as alumina or titanium diboride. The lattice structure and chemical homogeneity of the HEA matrix have been characterized. The dispersion of the reinforcements as well as the interfaces with the matrix were also investigated. The effect of reinforcement was evaluated by measuring the mechanical properties such as hardness and compressive strength.

Innovative Aspect(s) :
The innovative aspects of this study are mainly the following: The Fabrication of a new HEA Matrix Composite with interesting properties ; The use of a novel less energy consuming and faster fabrication route, consisting in producing the HEA and sintering the composite in the same step.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M12
ID : 6281484

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Hard Metals & Cermets

Author : Dr Toller-Nordström Lisa (KTH Royal Institute of Technology, Sweden)

Co-author(s) : Dr Borgh Ida (Sandvik Mining and Rock Technology, Sweden); Ms Sten Stella (Sandvik Mining and Rock Technology, Sweden); Prof Norgren Susanne (Sandvik Mining and Rock Technology, Sweden); Prof Borgenstam Annika (KTH Royal Institute of Technology, Sweden)

Title : Hardmetals With Novel Binder Phase Systems

Keyword(s) :
Hardmetal, Cemented Carbide, Alternative Binder, Characterisation

Abstract :
Due to the increased demand of cobalt and its negative health aspects, as well as it being listed as a critical raw material, the metallic cobalt binder of hardmetals, or cemented carbides, need to be replaced or substituted with an alternative.Over a decade of intensive research into alternative binders has significantly increased our knowledge on how metals other than cobalt affect the production and performance of hardmetal tools. Still, many challenges remain for complete substitution of cobalt across applications.Current efforts are focused on exploring more complex alloy systems that in turn may lead to formation of new phases and microstructures whose effect on the performance are yet unknown. This work presents recent advances in alternative binder research using steel based binder phases and what benefits these systems can bring. Thermodynamic calculations, electron microscopy and x-ray diffraction are used to characterise and analyse the material.

Innovative Aspect(s) :
Much of existing research on alternative binders for hardmetals have focused on pure elements or alloys of two or three elements, or the proposed binder phase has been an existing advanced alloy but without full consideration of the complex situation of stress state, grain size, mean free path and dissolution of hard phases that will ultimately lead to much different properties of the binder phase compared to a bulk alloy of the same target composition.This work considers previous research and combines that knowledge with thermodynamic calculations to design complex alloys to be used specifically as a binder phase in a hardmetal. Advanced characterisation techniques are used to evaluate the resulting material to further our knowledge on alternative binder hardmetals.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M13
ID : 6281545

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Hard Metals & Cermets

Author : Dr Ing Guillen Pineda Rene Miguel (Hyperion, Spain)

Co-author(s) : Dr Ther Oliver (Hyperion, Spain)

Title : Design Of Cermet Materials: Influence Of Ti Hard Phases Raw Material

Keyword(s) :

Abstract :
Cermet materials are a good alternative to cemented carbide for cutting applications due to their higher hot hardness, nevertheless this family of materials is more complex to use due to their relatively lower toughness in comparison to cemented carbides.This study is focused on the influence of Ti raw materials used for the composition of cermet and their influence on the final mechanical properties. A comparison between the materials TiC, TiN and TiCNs, showed that the use of Ti (C, N) s brings a strong improvement of the final properties over the usage of TiC and TiN. A deeper look at the effect of the C and N ratio (30-70, 50-50, and 70-30) initially present in the TiCN raw material highlighted a surprising behavior. In these materials hardness is decreasing with the increase of N content, even though N is a well-known grain growth inhibitor for Ti hard phase.

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 PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M14
ID : 6281538

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Hard Metals & Cermets

Author : Mr Singh Indeevar (Indian Institute of Technology Roorkee, India)

Co-author(s) : Dr Dabhade Vikram (Indian Institute of Technology Roorkee, India); Dr Debata Mayadhar (CSIR-Institute of Minerals and Materials Technology, India); Dr Panigrahi Ajit (CSIR-Institute of Minerals and Materials Technology, India)

Title : Role Of Nb Addition In W-Ni-Fe And W-Ni-Fe-Co Tungsten Heavy Alloys

Keyword(s) :
Tungsten Heavy Alloy, W-Nb Intermetallics, Sinterability

Abstract :
The potential advantage of adding niobium to tungsten heavy alloys owing to its lower thermal conductivity and specific heat beneficiary for kinetic energy penetrators is still unexplored. The effect of Nb addition in WHA for its sinterability, densification and microstructure attributes is investigated in this study to explore this uncharted area. In this study, two different compositions of WHA, 90W – 7:3(Ni:Fe) and 90W – 6:2:2(Ni:Fe:Co), were blended with Nb at different concentrations (1.25, 2.5 and 3.75 wt%) followed by compaction and sintering in a reducing atmosphere at 1500 oC. The finding suggested larger tungsten grain formation with Nb addition in both the alloy compositions along with formation of Nb-oxides and W-Nb intermetallics. Increasing Nb concentration hindered sinterability and densification in the Ni:Fe alloy, but an opposite trend was found for the Ni:Fe:Co alloy. This study offers insight into using niobium as a promising alloying element in tungsten-heavy alloys (WHA).

Innovative Aspect(s) :

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M15
ID : 6281340

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Hard Metals & Cermets

Author : Dipl-Ing Berger Christian (Fraunhofer IKTS, Germany)

Co-author(s) : Dr Ing Scheithauer Uwe (Fraunhofer IKTS, Germany); Dr Ing Pötschke Johannes (Fraunhofer IKTS, Germany)

Title : Comparison Of Different Binder-Jetting Printers For Additive Manufacturing Of Hardmetals

Keyword(s) :
Cemented Carbide, Powder, Additive Manufacturing, FESEM, Hardness, Hardmetal, Binder Jetting

Abstract :
Binder-jetting (BJT), a sinter and powder-based additive manufacturing technology, is becoming more and more established on the market due to its high productivity and the wide variety of materials it can process. The production of WC-Co based hardmetals is being promoted by well-known hardmetal and powder manufacturers using the BJT technology. Within this study, five different binder jetting printers from four different manufacturers were tested and compared for their suitability for the production of hardmetals. In addition to hardmetal properties, printing performance and green part handling are compared and the investigated differences discussed. The studies shows, that all tested BJT printers show the principle feasibility of producing hardmetal green parts which can after sintering yield dense samples.

Innovative Aspect(s) :
For the first time investigations about the production of hardmetal green parts on five different binder jetting printers were done. Previously, only ExOne binder jetting manufacturers were used, with a few exceptions. The study proves that dense hardmetals can be produced with binder jetting printers from different manufacturers using different binder fluids and process approaches.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M16
ID : 6281346

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Hard Metals & Cermets

Author : Mr Spalden Mathias von (Fraunhofer IKTS, Germany)

Co-author(s) : Dipl-Ing Vornberger Anne (Fraunhofer IKTS, Germany); Dr Ing Pötschke Johannes (Fraunhofer IKTS, Germany)

Title : Influence Of Various Alloying Elements On WC-Ni Hardmetals

Keyword(s) :
Hardmetal, WC, FAST, SPS, Co Free, Alternative Binder Systems

Abstract :
The substitution of cobalt in hardmetals has a crucial economic role, since increasing costs driven by the demand for Li-ion batteries can lead to higher prices for the majority of hardmetal grades which depend on cobalt as binder metal. Nickel has already proven to be a possible substitute. However, so far it cannot compete with cobalt in terms of mechanical properties. Therefore, in this work a systematic investigation on various alloying elements in nickel-based binder systems for hardmetals was done. A further goal of this study was the reduction of needed sintering temperatures which can lead to less energy consumption for the sintering process. The trials were carried out using field assisted sintering. Subsequent SinterHIP treatment was done to investigate quasi thermodynamicall state. The chosen alloying elements are iron, manganese, copper, silicon, and germanium. For some combinations, hardmetals with a novel nickel-based binder alloy could be successfully prepared.

Innovative Aspect(s) :
To the authors' knowledge there have not been any systematic studies on alloying nickel in situ with various elements as binder systems for hardmetals in combination with the preparation by a field assisted sintering technique.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M17
ID : 6281361

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Hard Metals & Cermets

Author : Dipl-Ing Vornberger Anne (Fraunhofer IKTS, Germany)

Co-author(s) : Dr Ing Pötschke Johannes (Fraunhofer IKTS, Germany); Dr Ing Steinborn Clemens (Fraunhofer IKTS, Germany); Prof Dr Michaelis Alexander (Fraunhofer IKTS, Germany)

Title : Empirical Hot Hardness Model Of WC-Co Hardmetals

Keyword(s) :
Hardmetal, Cemented Carbide, WC-Co, Mechanical Properties, Hardness, Temperature

Abstract :
Hardmetals or cemented carbides are a widely used material for tools due to their excellent mechanical properties. In many applications WC-Co tools operate at high temperatures, which shows why the hot hardness of this material is of high interest. In this work the hot hardness of numerous WC-Co hardmetal samples was measured up to 900 °C. The metallic binder contents ranged between 0 wt% and 20 wt% Co and WC grain sizes between 0.1 and 1.5 µm. Both Co content and WC grain size significantly influence hot hardness, but the degree of influence changes with the temperature. An empirical model to estimate the hardness of WC-Co hardmetals up to 900 °C as a function of WC grain size and Co content is proposed and discussed.

Innovative Aspect(s) :
For the first time a relationship between hardness, temperature and composition|microstructure of WC-Co hardmetals is presented. This makes it possible to estimate the hot hardness up to 900 °C for a wide range of hardmetal grades from the room temperature hardness, WC grain size and Cobalt content. This offers an alternative to time-consuming and expensive hot hardness tests.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M18
ID : 6281388

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Hard Metals & Cermets

Author : Dr Ing Müller-Köhn Axel (Fraunhofer IKTS, Germany)

Co-author(s) : Dipl-Ing Hering Michael (Konrad Friedrichs GmbH & Co KG, Germany); Dipl-Ing Abel Johannes (Fraunhofer IKTS, Germany); Ing Jucan Ovidiu (Gühring SRL, Romania); Dipl-Ing Jegust Stephan (Inmatec Technologies, Germany); Dr Ing Pötschke Johannes (Fraunhofer IKTS, Germany); Dr Ing Moritz Tassilo (Fraunhofer IKTS, Germany)

Title : Testing Of Hardmetal Cutting Inserts Additive Manufactured By Fused Filament Fabrication

Keyword(s) :
Fused Filament Fabrication, Additive Manufacturing, Indexable Inserts, Hardmetal, Machining, Cemented Carbide

Abstract :
Additive manufacturing allows machining tools to be specifically adapted to the machining task. However, currently the question remains whether additive manufactured hardmetal tools can achieve comparable performance to conventional produced hardmetal tools. In this study, hardmetal inserts manufactured using fused filament fabrication were tested in industrial machining trials on samples of AISI 304 (X5CrNi18-10). Due to their high degree of standardization and simple geometry, indexable inserts are well suited for such feasibility tests, although they do not have a geometry that requires or is advantageous for additive manufacturing. Within the presentation the whole process chain from powder up to the grinded tool will be shown. Specific issues for ensuring high material and component quality are discussed and an outlook into the use of ultrafine hardmetal powders more complex tools will be given. The promising results show great potential for complex special hardmetal tools, weight savings and conformal cooling.

Innovative Aspect(s) :
Application of ultrafine hardmetal powders in thermoplastic shaping; Complete processing off FFF-manufactured indexable inserts until ready to use tools- Assessment of FFF-manufactured hardmetal inserts in comparison to conventional produced hardmetal tools for machining of AISI304.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : P-M19
ID : 6278247

Requested presentation type : Poster Presentation

Topic : Materials **Subtopic :** Hard Metals & Cermets

Author : Mr Leclef Arnaud (UMONS, Belgium)

Co-author(s) : Dr Ing Mégret Alexandre (UMONS, Belgium); Prof Dr Tricoteaux Arnaud (UPHF, France); Prof Dr Vitry Véronique (UMONS, Belgium)

Title : Carbon-doped FeMn-based Binders For Tungsten Carbide

Keyword(s) :
Tungsten Carbide, Ball Milling, Vacuum Sintering, Hardness, Binders, Phase Diagrams

Abstract :
The use of cobalt as binder for tungsten carbide raises more and more questions of environmental, health and societal ethics. The aim of this study is to find alternatives to cobalt as a binder for tungsten carbide. Tested binders were FeMn-based binders. The latter were carbon-doped to prevent the presence of eta-phase. Expected results required HV30 > 1600, fracture toughness > 10 MPa.m1|2, and a corrosion resistance equivalent to WC-Co composites. The first aspect is to model the phases that were generated by the replacement of cobalt. Pseudo-binary phase diagrams have been performed. The second aspect was to process the alternative "WC – promising alternative binder" composites. The powder metallurgy method was chosen for this purpose. Vacuum sintering technology was used. The samples were then mechanically and morphologically characterized. Corrosion resistance was also analyzed.

Innovative Aspect(s) :
The use of FeMn alloys as substitutes for cobalt as binders for tungsten carbide is rare in the literature. Furthermore, the study of carbon-doping the FeMn binder to inhibit the presence of eta-phase in the WC-FeMn composite has not been pursued in the past.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : P-M20
ID : 6281335

Requested presentation type : Poster Presentation

Topic : Materials **Subtopic : Hard Metals & Cermets**

Author : Prof Senos Ana (Department of Materials and Ceramics Engineering CICECO, Portugal)

Co-author(s) : Dr Fernandes Cristina (Palbit, Portugal); Dr Ferrari Begoña (Institute of Ceramic and Glass (ICV-CSIC), Spain); Dr Sanchez-Herencia A.J. (Institute of Ceramic and Glass (ICV-CSIC), Spain); Dr Chirico Caterina (Institute of Ceramic and Glass (ICV-CSIC), Spain)

Title : Debinding And Sintering Of WC-Ni Samples Obtained By Material Extrusion Of A Thermoplastic Composite

Keyword(s) :
Material Extrusion, Hardmetal, Debinding, Colloidal Processing

Abstract :
Material Extrusion (MEX) is a promising technique for AM of high-performance hardmetal components, allowing to obtain complex shapes, including internal cavities, which are necessary in cooling systems of cutting tools.In this work, the effect of different atmospheres (Air, Ar, and N2-H2) during debinding was studied. Filaments contain 45 vol.% of hardmetal powders (WC-Ni) with 10 and 15 vol.% Ni and PLA-based thermoplastic matrix. Debinding was performed using a tube furnace up to 800 °C. Samples were sintered up to 1450 °C in Ar atmosphere at 30 bar, using a sinter-HIP furnace. This thermal cycle also includes a debinding at 600 °C in H2 atmosphere.The microstructure is similar to that obtained in conventional processed hardmetal, achieving a relative density between 92 and 97%. Most of the defects observed are related to the printing process. Sintered samples were microstructural characterized using SEM, carbon content was evaluated by direct combustion technique.

Innovative Aspect(s) :
This work studies the effect of different atmospheres during the debinding of hardmetal parts produced by MEX in order to enhance the polymer removal, maintaining the structural integrity, and reducing the amount of residual carbon that could allow the precipitation of secondary phases, usually associated with the detriment of mechanical properties. Furthermore, this work proposes a "low-cost" and efficient approach that reduces the consumption of inert gas employed during the thermal cycle. To do this, it is performed a cycle using air in much of the debinding process and subsequently changing to an N2-H2 atmosphere. In this way, the polymer combustion is favored, and the sample remains without oxidation.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : P-M21
ID : 6282720

Requested presentation type : Poster Presentation

Topic : Materials **Subtopic : Hard Metals & Cermets**

Author : Mrs Collado Cipres Veronica (Sandvik Coromant, Sweden)

Co-author(s) : Prof Llanes Luis (UPC, Spain); Prof Cabrera José Maria (UPC, Spain); Dr Ing Garcia José (Sandvik Coromant, Sweden)

Title : Constitutive Relationships For WC-Co During High-temperature Deformation

Keyword(s) :
Cemented Carbide, WC-Co, Hot Deformation, Constituive Equation, Creep Exponent, Activation Energy

Abstract :
Hot deformation of sintered WC-Co cemented carbides during hot compression testing was investigated in the temperature range of 700 to 1000°C and at strain rates from 0.0005 to 0.1 s-1.The stress-strain flow curves exhibited a peak followed by cavities leading to failure, and no steady-state stress was achieved. Cemented carbides with 6, 10, 12.5, 15 and 20 wt% Co and equal WC grain size were tested to describe the influence of the binder content. Constitutive equations were used to derive the flow stress behaviour of each composition. A physically based approach to find the materials constants accounting for the change of the microstructure with temperature was used. A fitting model to describe deformation rate according to stress was suggested for temperatures between 775 and 1000°C and the deformation mechanisms taking place were discussed.

Innovative Aspect(s) :
It is the first methodical approach to understanding the high temerature deformation behaviour of WC-Co materials. Instead of cree, hot deformation was used in order to have the closest conditions to cutting tool application deformation. The analisis of the results leads to constitutive equations never developed before.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024 CONGRESS & EXHIBITION

Technical Programme Committee
8th of February 2024

MATERIALS

ULTRA HARD MATERIALS

EPMA
european powder metallurgy association

EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M22
ID : 6281649

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic : Ultra Hard Materials**

Author : Miss Navarrete Cuadrado Jazmina (CEIT-BRTA, Spain)

Co-author(s) : Dr Soria Biurrun Tomas (CEIT-BRTA, Spain); Dr Lozada Cabezas Lorena (CEIT-BRTA, Spain); Dr Alveen Patricia (Formerly at HILTI Co., now at EURICE, Germany); Dr Moseley Steven (Hilti Corporation, Liechtenstein); Prof Dr Sanchez-Moreno Jose M. (CEIT-BRTA, Spain)

Title : New Ultrahard Ceramics And Ceramic-metal Composites Based On Tungsten Tetraboride

Keyword(s) :
Tungsten Tetraboride, HIP, Ceramics, Reactivity With Ni Powders

Abstract :
WB4-B and WB4-TaB2 based materials with hardness values over 43 GPa have been obtained by glass encapsulated HIPing. Sintering of WB4-B-TaB2 powders is significantly activated by Ni additions. Porosity removal is achieved at 1100°C-150 MPa- 1hour, that is, 250°C below the temperature needed without nickel. However, there is strong chemical reactivity between Ni and WB4-B-TaB2 powders leading to the formation of W2B5, NiB, Ni4B3 and M2B5 phases. Since no metallic nickel remains after sintering, these ceramic composites are very brittle. Strength and toughness of WB4-B-TaB2-Ni alloys are notably improved by TiAl3 and Zr additions. Although Ni containing borides are still present in these materials, there are also Ni-rich regions free of boron after sintering, which provide a significant strengthening effect, reaching TRS values near 1 GPa. However, when Zr is added to the mixtures, WB4 grains are fully decomposed into a combination of mixed borides.

Innovative Aspect(s) :
Production of new ultrahard WB4-B ceramics by HIP at temperatures 300°C below those reported so far for these materials achieving nanohardness values over 43 GPa; Analysis of the reactivity between WB4-B powders and Ni additions. Identification of phases formed after sintering; Control of chemical reactions between WB4-B and Ni by additions of TiAl3 and Zr with the aim of producing tougher ceramic metal composites

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024

CONGRESS & EXHIBITION

Technical Programme Committee

8th of February 2024

MATERIALS

FERROUS MATERIALS

EPMA

european powder metallurgy association

EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M23
ID : 6206688

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Ferrous Materials

Author : Prof Dr Danninger Herbert (Technische Universität Wien, Austria)

Co-author(s) : Dr Hojati Milad (Technische Universität Wien, Austria); Prof Dr Gierl-Mayer Christian (Technische Universität Wien, Austria)

Title : Introduction Of Carbon Into Sintered Steels By Combining Graphite And Fe-C Masteralloys

Keyword(s) :
Sintered Steels, Sintering, Carbon, Masteralloys

Abstract :
Carbon is typically introduced into sintered steels through admixed fine graphite, the dissolution during sintering however being relatively slow. An alternative route would be the introduction via a carbon-rich Fe-C powder containing carbon as cementite. In the present study it is shown that already addition of a minor proportion of carbon through atomized Fe-4.5%C masteralloy powder activates carbothermal reduction of the surface oxides, shifting the CO formation temperature to lower levels, as well as dissolution of graphite in the matrix. This is particularly noticeable in steels prepared from prealloyed steel powder Fe-3%Cr-0.5%Mo. The property most sensitive to carbon dissolution is the coercive force, which offers the chance to nondestructively characterize this important process.

Innovative Aspect(s) :
It is shown that in PM steel compacts already a minor fraction of carbon present as cementite accelerates the reactions occurring during heating up to sintering temperature, promoting also the dissolution of graphite. This offers advantages in particular for systems for which sintering has to be done at moderate temperatures, e.g. to avoid unwelcome side reactions.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M24
ID : 6228829

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic : Ferrous Materials**

Author : Dr Eskandari Sabzi Hossein (Globus Metal Powders, United Kingdom)

Co-author(s) : Dr Hamilton Andrew (University of Southampton, United Kingdom); Dr Hao Xinjiang (Globus Metal Powders, United Kingdom); Prof Rivera Pedro (University of Southampton, United Kingdom)

Title : Transformation-induced Plasticity In Additively Manufactured Tool Steel

Keyword(s) :
Additive Manufacturing, Transformation-induced Plasticity, Tool Steel, Austenite Stability

Abstract :
A significant challenge in the additive manufacturing (AM) of high-performance steels is to promote transformation-induced plasticity (TRIP). TRIP is a mechanically-induced martensitic transformation of retained austenite distributed in a ferritic or martensitic matrix. Austenite stabilisation and retention at room temperature is of paramount significance to promote TRIP. In this work, it was discovered that austenite could be effectively retained after AM by precipitation of carbides and the formation of bainite during AM. The ultimate tensile strength then increases significantly as a result of this metastable austenite's gradual transformation to -martensite under straining, while exhibiting a high yield strength. The partitioning of stress and strain, which is constantly changing as the hard martensite forms, is the cause of this rise, as revealed by advanced microscopy techniques.

Innovative Aspect(s) :
This abstract highlights the following innovative aspects in the AM of high-performance steels with TRIP effect: Challenges in AM of high-performance steels tool steels and how to retain an austenitic matrix upon printing, in order to promote TRIP effect during deformation. Characterisation of mechanically-induced martensitic transformation. Mechanical properties correlation with microstructural features.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M25
ID : 6252913

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic : Ferrous Materials**

Author : Mr Becker Louis (Chair of Materials Technology, Ruhr University Bochum, Germany)

Co-author(s) : Mr Radtke Felix (Institute of Applied Powder Metallurgy and Ceramics at RWTH Aachen e. V., Germany); Dr Ing Lentz Jonathan (Chair of Materials Technology, Ruhr University Bochum, Germany); Dr Ing Herzog Simone (Institute of Applied Powder Metallurgy and Ceramics at RWTH Aachen e. V., Germany); Prof Dr Broeckmann Christoph (Institute of Applied Powder Metallurgy and Ceramics at RWTH Aachen e. V., Germany); Prof Dr Weber Sebastian (Chair of Materials Technology, Ruhr University Bochum, Germany)

Title : An Innovative Approach To The Additive Manufacturing Of High Nitrogen Austenitic Stainless Steel

Keyword(s) :
Additive Manufacturing, High Nitrogen Steels, Diffusion Alloying

Abstract :
Laser Powder Bed Fusion|Metal (PBF-LB|M) shows great promise for industrial applications, but its extended production time remains a challenge. To address this, innovative methods such as the shell-core approach have been developed. In this procedure, a component is created with a dense outer shell surrounding a core of either unexposed or minimally exposed powder, drastically reducing processing time. Full densification and specific property adjustment are achieved by subsequent hot isostatic pressing (HIP). This study demonstrates the use of shell-core specimens made from a blend of austenitic steel and Si3N4 to produce high-nitrogen steel components that are otherwise difficult to produce due to limited nitrogen solubility in the steel melt. During HIP, Si3N4 dissolves into the austenitic matrix, enriching it with nitrogen and circumventing solubility issues. This results in a material with increased strength and potentially improved corrosion resistance due to the beneficial effects of nitrogen on steel properties.

Innovative Aspect(s) :
This work is the first to exploit the use of the shell-core strategy for targeted diffusion alloying during the downstream hot isostatic pressing of additively manufactured steels. In doing so, we offer a new approach to producing additive-manufactured stainless steels with N contents above the maximum nitrogen solubility in the steel melt, improving mechanical and chemical properties.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M26
ID : 6275409

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic : Ferrous Materials**

Author : Dr Kairet Thomas (Sirris, Belgium)

Co-author(s) : Dr Malet Loïc (Université Libre de Bruxelles, Belgium); Prof Godet Stéphane (Université Libre de Bruxelles, Belgium); Dr Kuci Erin (Cenaero, Belgium)

Title : L-PBF Of Fe-Si6,5% Soft Ferromagnetic Powder: Thin Walls Structures While Processing A Complex Material

Keyword(s) :

Abstract :
Fe-Si6,5% is a complex material to print by L-PBF. The brittle phases formed during processing make the material sensitive to internal stresses. The paper shall show the processing issues to obtain a good material health based on optical microscopy, defect analysis and classification. The manufacturing of thin walls have yielded better results than thick bulk material and various laser melting strategies shall show the trend between single meltpool and multiple meltpool thicknesses. EBSD analysis of these walls shall show the internal grain texture of the wall. Furthermore, the magnetic hysteresis cycle of the printed material has been measured using a vibrating magnetometer.

Innovative Aspect(s) :
The high content of silicon made it difficult to process the material by L-PBF but specific strategies and machine setting improve the likelyhood of success. Thin wall structures are much easier to print with the L-PBF process.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M27
ID : 6278527

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Ferrous Materials

Author : Mr Sorea Alexandru (Sintex A|S, Denmark)

Co-author(s) : Mr Valler Peter (Sintex A|S, Denmark); Mr Kjeldsteen Peter (Sintex A|S, Denmark); Mr Kaae Phillip Hjelmeborn (Grundfos A|S, Denmark)

Title : Densification Of Metal Powder Extruded AISI 904L To Increase Corrosion Resistance

Keyword(s) :

Abstract :
Metal powder extrusion (MPE) of AISI 904L super austenitic stainless steel makes it possible to produce complex structures with a higher corrosion resistance compared to austenitic stainless steels such as AISI 304L and AISI 316L. The initial sintering trials resulted in a porous part with low corrosion resistance. As AISI 904L is a steel with austenitic phase through the entire sintering window, densification during sintering was inhibited which resulted in the reduced corrosion resistance due to open porosities. This paper will show how to enhance densification in order to improve the corrosion resistance closer to the expected level comparable to cast and rolled material but with the shaping possibilities of MPE.

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 PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M28
ID : 6278588

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Ferrous Materials

Author : Mr Radtke Felix (Institute of Applied Powder Metallurgy and Ceramics (IAPK), Germany)

Co-author(s) : Mr Mirz Markus (Institute for Materials Applications in Mechanical Engineering (IWM), Germany); Mr Dollmeier Klaus (Georgsmarienhütte Holding GmbH, Germany); Dr Ing Herzog Simone (Institute for Materials Applications in Mechanical Engineering (IWM), Germany); Prof Dr Broeckmann Christoph (Institute for Materials Applications in Mechanical Engineering (IWM), Germany)

Title : Developing Of A PBF-LB|M Process For Austenitic High Nitrogen Steel Alloy

Keyword(s) :
High Nitrogen Steels, Austenitic, PBF-LB|M, Mechanical Properties, Heat Treatment

Abstract :
Austenitic high nitrogen steels (HNS) are the material of choice in the aerospace, medical, food, and electronics industries due to their unique combination of high strength, ductility and corrosion resistance. Especially for small components, the use of additive manufacturing is attractive.In this study, the PBF-LB process was developed for the austenitic HNS grade X13CrMnMoN18-14-3. Analysis of key factors such as laser parameters and nitrogen content led to an optimized process. Solution annealing ensured a fully austenitic transformation of the unintended duplex structure on cost of the fine as-built microstructure. Advanced metallurgical analysis allows discussion of the effect of nitrogen content and microstructure on strength, hardness and fatigue behavior. With precise process control, the study achieves the desired material properties and contributes to the development of improved materials for the PBF-LB|M process, highlighting the versatility of austenitic HNS.

Innovative Aspect(s) :
The manufacturing parameters determined in this work allow the material to be processed using the PBF-LB|M process for the first time. This makes it possible to directly compare the material properties of the conventional manufacturing route and the laser-based additive manufacturing route. The combination of thermodynamic calculations, metallographic investigations and thermal post-treatment allows the material to be precisely tuned to the required properties.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M29
ID : 6280981

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic : Ferrous Materials**

Author : Dr Frutos Torres Emilio (Commplutense University of Madrid, Spain)

Co-author(s) : Dr Cornide Arce Juan (Commplutense University of Madrid, Spain); Ing Cuenca Fernandez Daniel (Commplutense University of Madrid, Spain); Dr Encinas García Noemí (Commplutense University of Madrid, Spain); Dr Lasanta Carrasco M. Isabel (Commplutense University of Madrid, Spain); Dr Alcalá Penades Germán (Commplutense University of Madrid, Spain)

Title : Design Of High Fracture Toughness Structural Materials By Adjusting Microstructure And Mechanical Properties Of Fe7Cr7-xNi4+xTiMo High-entropy Alloys

Keyword(s) :
High entropy Fe-based Alloys, Eutectic, Microstructural and Mechanical Properties

Abstract :
Eutectic high entropy alloys (HEAs), with lamellar arrangement of solid solution phases, represent a new paradigm for simultaneously achieving high strength and ductility, thereby circumventing this well-known trade-off in conventional and single-phase HEAs alloys. However, dynamic strengthening mechanisms and phase-boundary interactions during external loading remain unclear for these multiphase systems. The large fraction of phase boundary significantly impacts plastic flow in these systems. In this study, the microstructure, based on a mixture of a majority L12, B2 and a minority of s solid-solution phases, and small-scale mechanical behaviour has been evaluated for Fe7Cr7-xNi4+xTiMo (x=0, 1, 2 and 3) high entropy alloys obtained from of mechanically alloyed powders by spark plasma sintering (SPS). The use of nanoindentation tests has allowed us to characterize the values of hardness, resistance, sensitivity to strain rate and friction coefficient shown by the different B2|L12 ratios presented by high-entropy Fe-rich alloys.

Innovative Aspect(s) :
Phase-specific nanoindentation tests have revealed higher hardness, sensitivity strain rate and coefficient of friction for B2 compared to L12. These results will pave the way for a fundamental understanding of phase-specific contribution to bulk mechanical response of high entropy Fe-rich alloys and help in designing structural materials with superior fracture toughness.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M30
ID : 6281345

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Ferrous Materials

Author : Mr Korir Patrick (Höganäs AB, Luleå University of Technology, Sweden)

Co-author(s) : Dr Vattur Sundaram Maheswaran (Höganäs AB, Sweden); Prof Surreddi Kumar Babu (Luleå University of Technology, Sweden); Dr Forouzan Farnoosh (Höganäs AB, Sweden); Dr Chasoglou Dimitris (Höganäs AB, Sweden); Prof Antti Marta-Lena (Luleå University of Technology, Sweden)

Title : Enhancement Of Hardenability And Performance With Addition Of Master Alloy Powder In PM Steels: Effect Of Different Atomisation Techniques

Keyword(s) :
Master Alloy, Hardenability, Compressibility, Liquid Phase Sintering

Abstract :
In PM steels, alloying through master alloy (MA) addition enables introduction of oxygen-sensitive elements such as Cr, Mn, and Si. These elements are cost-effective and sustainable alternatives to replace Cu and Ni to enhance hardenability and performance. This study investigates the atomisation of Fe-Cr-Mn-Si-C MA powders using three different techniques: water atomisation, gas atomisation, and gas atomisation-water cooling. The MA powders were sieved into two size fractions, and mixes were prepared with Fe-0.85wt.% Mo pre-alloyed base powder and graphite. MA powder characterisation, compressibility, and dilatometry-sintering were performed to evaluate the different atomisation techniques, the behaviour of MA powder mixes during pressing, and the liquid phase formation at various sintering temperatures. The results indicated that MA addition significantly improved the hardenability and performance especially after sintering above 1200°C, once the MA melting and alloy homogenisation had occurred. Additionally, industrial sintering trials were conducted, and mechanical properties were assessed.

Innovative Aspect(s) :
The paper demonstrates the master alloy route to improve the properties of PM components, pressed and sintered by using more sustainable materials such as Cr, Mn and Si in the master alloy powder. The paper provides an opportunity to select a suitable production route for the master alloy powders. By evaluating how the different size fractions of the master alloy powder influences the final PM component properties, right particle size distribution of these powders can be used for the application.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M31
ID : 6281494

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic : Ferrous Materials**

Author : Dr Ing Tekin Tugce (University of Trento, Italy)

Co-author(s) : Ing Naclerio Francesco (Pontillo Officine Meccaniche & C., Italy); Prof Dr Ipek Rasim (Ege University, Turkey); Prof Dr Molinari Alberto (University of Trento, Italy)

Title : Fatigue Strength Of Heat And Surface Treated Maraging Steel Manufactured By L-PBF

Keyword(s) :
Fatigue Strength, Nitriding, Thin Film Coating, Maraging Steel, Laser Powder Bed Fusion, Additive Manufacturing

Abstract :
The axial fatigue strength of maraging steel produced by Laser Powder Bed Fusion (L-PBF) and subject to different heat and surface treatments was investigated. The following treatments were considered: Solution Annealing and Aging (SAT), Direct Aging of the as-built material (DAT), and two surface duplex treatments made of a prior plasma nitriding followed by a PVD coating with different nitriding time (C and NC). The fatigue strength of SAT is a bit higher than that of DAT steel because of the slightly higher hardness and lower amount of austenite in the microstructure.The surface-treated material displays a 40-50% higher fatigue strength than the two heat-treated materials, thanks to the surface hardening provided by nitriding. The fatigue behaviour was correlated to hardness and in particular to defects observed in the material resulting from the L-PBF process, whose size and position were analyzed on the fracture surfaces of all the fractured.

Innovative Aspect(s) :
The innovative aspect of this work is the study of the fatigue strength of an 18Ni300 maraging steel manufactured by L-PBF after a surface duplex treatment: nitriding followed by PVD. The fatigue strength of heat-treated maraging steel is reported in the literature, but only a few works are available relevant to the influence of plasma nitriding. Duplex treatments are aimed at improving wear resistance, prior to nitriding having the scope of hardening the substrate to be coated. The work shows that on increasing nitriding time, surface hardening increases but the content of austenite in the material also increases. The combined effect results in a slight but significant decrease in fatigue strength.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M32
ID : 6281555

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic : Ferrous Materials**

Author : Mr Vaddamanu Satya Chaitanya (Chalmers University of Technology, Sweden)

Co-author(s) : Dr Wärner Hugo (SSAB Special Steels, Sweden); Dr Fager Ulrika (SSAB Special Steels, Sweden); Prof Hryha Eduard (Chalmers University of Technology, Sweden)

Title : PBF-LB Processability, Microstructure And Properties Of Advanced High Strength Powder Steel

Keyword(s) :
Addtive Manufacturing, Ferrous Materials, PBF-LB

Abstract :
With the advent of additive manufacturing (AM), there is a need for new materials in the field of structural applications. The primary challenge hindering the widespread use of traditional ferrous materials for this purpose is the high carbon content (>0.1 %), making processability by AM rather challenging due to the high cracking susceptibility of the materials. This study explores the processability of a novel low-alloyed steel powder using Powder Bed Fusion - Laser Beam (PBF-LB), the connection between process parameters, and resulting microstructure and properties. Developed process parameters allowed to obtain fully dense (~99.9%), and crack free specimens over a large processing window. Detailed microstructure analysis was performed using different microscopy techniques, revealing the relationship between process parameters and characteristics of the melt pools, as well as the resulting fine martensitic microstructure. The mechanical properties of the alloy were evaluated using specimens processed with the optimized process parameter set.

Innovative Aspect(s) :
This study present an in-depth overview of the processability characteristics of a novel high strength powder steel, by characterising the melt pools created during PBF-LB processing. This will allow for its future use as a potential material candidate for being used in AM processing.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M33
ID : 6281719

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Ferrous Materials

Author : Dr Hao Xinjiang (Globus Powder Metals Ltd, United Kingdom)

Co-author(s) : Dr Eskandari Sabzi Hossein (Globus Metal Powders Ltd, United Kingdom); Prof Rivera-Díaz-del-Castillo Pedro (University of Southampton, United Kingdom)

Title : High Strength Martensitic Steel Development For Additive Manufacturing

Keyword(s) :
Additive Manufacturing, LPBF, Steel Powder, Alloy Development

Abstract :
Globus Metal Powders Ltd (formerly known as Liberty Powder Metals Ltd) was set up in the UK in 2019 to develop high performance metal powders for additive and net-shape manufacturing. The paper gives an overview of our alloy development programme for additive manufacturing, including powder production, powder characterisation, LPBF process development, microstructure, and mechanical properties of a range of high strength martensitic steels. Examples including precipitation hardening stainless steels (modified 17-4PH, 13-8Mo) and ultra-high strength alloy steel (300M) are provided with details.

Innovative Aspect(s) :
New alloy development for Additive Manufacturing

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M34
ID : 6281794

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic : Ferrous Materials**

Author : Mr Schneider Paul (Höganäs AB, Sweden)

Co-author(s) : Miss Ljung Karin (Höganäs AB, Sweden); Dipl-Ing Szabo Christophe (Höganäs AB, Sweden)

Title : Mechanical Properties Of Astaloy®CrS, A Lean Cr-alloyed Base Powder, After Sinterhardening

Keyword(s) :
Sinterhardening, Astaloy®CrS, low Cr Alloyed, Mechanical Properties, Composition Selection

Abstract :
Sinterhardening is a commonly applied cost effective process for producing higher loaded structural P|M parts. Generally, a prealloyed base powder is combined with further external alloying elements such as Ni or Cu in order to maintain the compressibility of the base powder. Astaloy®CrS is a newly developed low alloyed base powder prealloyed with 0,85% Cr and 0,15%Mo. This paper is investigating the mechanical properties after sinterhardening of various graphite and Ni additions admixed to Astaloy® CrS . Recommendations of practically suitable alloy combinations will be given as a outcome of this investigation.

Innovative Aspect(s) :
Sinterhardening guide for a new cost effective Cr alloyed base powder in combination with Ni and graphite additions. Practical mix combinations for parts production will be suggested.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M35
ID : 6281798

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic : Ferrous Materials**

Author : Mr Sepako Motheo (Stellenbosch University, South Africa)

Co-author(s) : Ms Mkhaliphi Thuli (Stellenbosch University, South Africa); Ms Blaine Deborah (Stellenbosch University, South Africa)

Title : Determining Suitable Processing Parameters To Produce AISI 420 Stainless Steel Using Laser Powder Bed Fusion

Keyword(s) :
Laser Powder Bed Fusion (L-PBF), AISI 420 Stainless Steel (420SS)

Abstract :
The study investigates the optimization of processing parameters for Laser Powder Bed Fusion (L-PBF) in the production of AISI420 stainless steel (420SS). The objective is enhancing specific properties of 420SS through controlled variations in L-PBF processing parameters. The research focuses on the effect of energy density, laser power, scan speed and hatching spacing on the part density, porosity, microstructure, and mechanical properties of the as-built samples. The findings reveal that as-built samples with a relative density exceeding 99% utilized energy density values ranging from 79.4 to 136.6 J|mm³ and laser power above 150 W. Samples featured porosity levels below 0.01%, characterized by uniformly distributed small pores measuring less than 30 µm. The microstructure displayed retained austenite phases, with additional presence of martensite phases at the melt pool boundary, attributed to rapid cooling process. The microhardness of the as-built samples exceeded 540 HV, surpassing those reported for cast 420SS.

Innovative Aspect(s) :
The paper provides a processing parameter window set for printing 420SS using laser powder bed fusion that achieves full part density. Consequently, the processing parameter window set is studied to provide a strategy on how the microstructure and microhardness of the as printed samples behaves and can be controlled. It further highlights how laser power, scan speed, hatch distance and energy density can be controlled to achieve the desired microstructure and mechanical properties. Consequently, gives a way on how an optimized set of parameters with desired properties can be achieved.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M36
ID : 6283286

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic : Ferrous Materials**

Author : Mr Eida Masaaki (Sumitomo Electric Sintered Alloy, Ltd., Japan)

Co-author(s) : Mr Hirao Yuki (Sumitomo Electric Sintered Alloy, Ltd., Japan); Dr Ing Saitou Tatsuya (Sumitomo Electric Sintered Alloy, Ltd., Japan); Dr Ing Ueno Tomoyuki (Sumitomo Electric Sintered Alloy, Ltd., Japan)

Title : Enhanced Functionality Of Soft Magnetic Composite Cores For Axial Flux Motors By Insulating Coating Technology

Keyword(s) :
Soft Magnetic Composite Core, Axial Flux Motor, Insulation Coating, High Heat Dissipation Property

Abstract :
The advancement of electric mobility as well as improvement in the efficiency of home appliances and industrial equipment have led to a need for higher performance motors. Axial flux motors (AFM) are attracting attention as a motor that meets the need because of their thin structure and high torque compared to radial flux motors. In order to realize these AFMs, magnetic cores that are suitable for the three-dimensional magnetic circuit are essential. So, we are developing soft magnetic composite cores (SMC) for AFMs with their magnetic isotropic properties and high design flexibility in shape. In this study, for ensuring insulation resistance between the SMC and the copper winding, we have developed insulate-coated SMC applies a resin coating to the core surface that has high dielectric strength and heat dissipation properties despite being thin, several tens of micrometers thick.

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 PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M37
ID : 6282623

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic : Ferrous Materials**

Author : Mr Schaefer Hendric (Ruhr-Universität Bochum, Germany)

Co-author(s) : Prof Dr Weber Sebastian (Ruhr-Universität Bochum, Germany); Dr Ing Lentz Jonathan (Ruhr-Universität Bochum, Germany)

Title : Powder Metallurgically Produced High Boron Tool Steels - A Step Towards Green Steel?

Keyword(s) :
Boron, Tool Steel, HIP

Abstract :
The use of boron as a hard phase forming element in cold work tool steels can improve performance, price, and environmental considerations all at once. This is achieved by reducing costly and high footprint elements, avoiding retained austenite and thus simplifying heat treatment. However, in boron-alloyed tool steels the formation of boride networks during casting impairs the mechanical properties. This, in turn, makes the powder metallurgy (PM) route all the more interesting and important as well as effective in improving material properties. In this study, we present two innovative boron-alloyed PM tool steels that are atomized and consolidated by HIP. Microstructural analysis is performed using SEM, EBSD and XRD and dynamic mechanical properties are evaluated. The results show that a combination of cost reduction through reduced element content combined with the isotropic microstructure of the PM-HIP production route can be achieved while improving mechanical properties.

Innovative Aspect(s) :
The path to a sustainable steel industry depends on two main framework conditions. Both energy and raw materials must be saved. The approach of boron-alloyed tool steels serves both by saving raw materials through lower alloy contents while the same or even better properties are achieved. These properties also enable simplified heat treatments, effectively saving energy.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : P-M38
ID : 6273980

Requested presentation type : Poster Presentation

Topic : Materials **Subtopic :** Ferrous Materials

Author : Prof Dorofeyev Vladimir (Platov South-Russian State Polytechnic University (NPI)), Russia)

Co-author(s) : Dr Sviridova Anna (Platov South-Russian State Polytechnic University (NPI)), Russia); Ms Sviridova Svetlana (Derzhavin Tambov State University, Russia); Dr Berezhnoi Yury (Platov South-Russian State Polytechnic University (NPI)), Russia); Dr Bessarabov Eugene (Platov South-Russian State Polytechnic University (NPI)), Russia); Dr Vodolazhenko Roman (MIREA - Russian Technological University, Russia)

Title : High-Temperature Heating Effect On The Transformation Of Non-Metallic Inclusions, The Structure And Properties Of Hot-Deformed Powder Steels

Keyword(s) :
Hot Forging, Porous Preforms, Mechanical Properties, Brittle and Ductile Fracture, Interparticle Jointing, Cohesion, Contact Interaction, Particle Surface, Alloying, Microalloying, Vanadium, Oxidation, Iron Powder, Dispersion Hardening, Dissolution – Prec

Abstract :
In order to decrease the negative impact of non-metallic inclusions on the properties of powder steels, the possibility of their diffusion dissolution during long-term high-temperature vacuum sintering or post-deformation annealing was studied. In the production of steels, iron powders with various contents of impurities were used. To decrease the tendency of austenite grains to grow, vanadium was added to the mixture composition. The content of carbon and vanadium was varied, as well as the modes of sintering and annealing. Heat treatment was performed after hot forging or annealing. The performance of high-temperature sintering or annealing causes a decrease in the size of non-metallic inclusions. Near the former particles of inclusions finely dispersed particles of secondary precipitates ("satellites") precipitate during the cooling process, which do not have a softening effect on the material. The modes of sintering or post-deformation annealing are determined, which provide the minimum sizes of inclusions.

Innovative Aspect(s) :
A decrease in size of non-metallic inclusions during high-temperature sintering reduces the risk of formation of micropores and microcracks at the sites of localization of these inclusions during hot repressing porous preforms. On the contrary, in the case of post-deformation annealing, micropores and microcracks that have arisen during hot repressing near large inclusions are practically not healed.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024

CONGRESS & EXHIBITION

Technical Programme Committee

8th of February 2024

MATERIALS

HIGH TEMPERATURE MATERIALS

EPMA

european powder metallurgy association

EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M39
ID : 6275441

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic : High Temperature Materials**

Author : Mr Peled Hagai (Tritone Technologies Ltd., Israel)

Co-author(s) :

Title : Production Of High-temperature Structural Materials Using A Slurry-based Feedstock Process

Keyword(s) :
High-Temperature Materials, Silicon Carbide, Molybdenum, Slurry-based Feedstock, Additive Manufacturing

Abstract :
High-temperature materials with low thermal expansion are of interest for various applications such as shields, lenses, and microelectronics.Silicon carbide (SiC) is a hard, strong, and thermally conductive structural ceramic that retains its properties at high temperatures. Molybdenum refractory metal is another example of a strong corrosion-resistant material with low thermal expansion.Additive manufacturing of printed pure SiC and Molybdenum parts is uncommon. Existing additive manufacturing processes of SiC parts produce porous SiC structures that go through a silicon infiltration procedure to produce hybrid silicon-SiC structures. This study demonstrated the production of molybdenum metal and SiC ceramics by the MoldJet process, which utilizes a slurry-based feedstock to fill, layer-by-layer, inkjet-printed molds to produce high-density green parts with a volume density of over 60%.The SiC and Molybdenum green parts were debinded and sintered to density volumes of over 99% and 95%, respectively, resulting in parts with exceptional properties.

Innovative Aspect(s) :
Conventional manufacturing techniques for high-temperature materials have limitations in terms of complexity and design freedom. Slurry-based additive manufacturing using high-temperature structural materials such as silicon carbide and molybdenum is an innovative new process that overcomes these limitations, enabling the creation of intricate, three-dimensional structures with exceptional thermomechanical properties by precise layer-by-layer deposition akin to traditional additive manufacturing techniques. The slurry-based nature of the feedstock imparts several advantages, including superior stress distribution, reduced thermal stresses, and enhanced material properties. This innovative approach paves the way for using slurry-based additive manufacturing as a game-changer in the production of high-temperature structural components.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M40
ID : 6278262

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** High Temperature Materials

Author : Dr Stenzel Melanie (TANIOBIS GmbH, Germany)

Co-author(s) : Dr Weinmann Markus (TANIOBIS GmbH, Germany); Dr Fayyazi Bahar (TANIOBIS GmbH, Germany); Dr Lenka Shaumik (Alloyed, United Kingdom); Mr Sim Nicolas (Alloyed, United Kingdom); Ms He Yining (Alloyed, United Kingdom); Mr Wagstaff Thomas (Alloyed, United Kingdom); Mr Ishino Yuji (Alloyed, United Kingdom); Mr Zhang Pimin (Alloyed, United Kingdom)

Title : Development Of Nb-base Alloy Powders For AM, MIM Or HIP Of Components For Application In Ultra-high Temperature Environments

Keyword(s) :
Nb-base Alloys, C-103, FS-85, Cb-752, High Entropy Alloy, ETMT Measurement, Temperatures > 1050°C

Abstract :
Many applications among aerospace, defence and energy generation require materials being capable to perform in high temperature environments. Niobium-base alloys are becoming particularly interesting if the temperatures exceed ~1050°C as they are outperforming even the most advanced Ni- and Co-base alloys. Notably, conventional production methods for Nb-base alloys are challenging, especially if parts with complex shapes are to be manufactured. The use of powder metallurgy e.g. AM, MIM or HIP, opens up new opportunities to produce complex-shaped parts economically. However, for these processes the application of suitable high quality powders is mandatory. In this context, the production of Nb-base alloys as powder feedstock using the electrode induction-melting gas atomization (EIGA) is reported. Powders and additively manufactured parts were investigated by X-ray diffraction, scanning electron microscopy, mechanical tests, and electro-thermal mechanical testing (ETMT). The mechanical performance i.e. strength of parts processed by L-PBF clearly outperforms that of conventionally manufactured parts.

Innovative Aspect(s) :
AM methods provides access to complex shaped parts capable to perform if the required temperatures exceed ~1050°C when using Nb-base alloys. Applicable powders have been made available and as a result of intensive development of material and in L-PBF process development, the part performance outperforms conventional manufactured parts clearly. From this staring point, the alloy development is further optimized to achieve materials with even higher temperature performance going beyonf 1400°C. Testing has been improved with Electro-thermal mechanical testing (ETMT) to be able to judge materials in the context for their application settings.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M41
ID : 6281642

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** High Temperature Materials

Author : Mr Martin Pablo (Delft University of Technology, Netherlands)

Co-author(s) : Dr Sánchez-Herencia Antonio J. (Institute of Glass and Ceramics ICV-CSIC, Spain); Dr Ferrari Begoña (Institute of Glass and Ceramics ICV-CSIC, Spain); Prof Cabrera Jose María (Technical University of Catalonia, Spain); Prof Santofimia María J. (Delft University of Technology, Netherlands)

Title : Milling Media Effect Over Sinterability, Microstructure, And Hardness Of Ultrafine-grained Al-Cr-Mo-Nb-Ti-V Refractory High-entropy Alloys Produced By Mechanical Alloying And Spark Plasma Sintering

Keyword(s) :
High-Entropy Alloys, Refractory High-Entropy Alloys, Mechanical Alloying, Spark Plasma Sintering, Microstructure

Abstract :
Refractory high-entropy alloys (RHEAs) are promising metallic materials for high-temperature applications, due to their outstanding mechanical properties at elevated temperatures. In this study, a series of lightweight RHEAs based on the Al-Cr-Mo-Nb-Ti-V system were prepared employing mechanical alloying and spark plasma sintering, utilizing either hardened steel and ZrO2 balls as grinding media in order to study their effect over microstructure and hardness. Both sintered parts exhibited ultrafine-grained microstructures with no porosity at all (densities below 7 g|cm-3), exhibiting a V,Mo-rich bcc matrix reinforced with Ti-rich carbide particles and nano-sized Al2O3 precipitates. Fe contamination from hardened steel grinding media caused the formation of Fe,Nb-rich Laves phases as well as a considerable reduction of the sintering temperature, while ZrO2 grinding media resulted in Zr-rich oxides particles homogeneously distributed throughout the microstructure. Lastly, both samples presented elevated hardness, reaching an elevated value of 1067 HV in the case of the first.

Innovative Aspect(s) :
The present article presents how the milling media affects the microstructural and morphological evolution of the milled powder, but also the microstructure and hardness of the as-sintered part of lightweight RHEAs. Additionally, the study reveals how the milling media had a considerable effect on the sintering temperature, showing that Fe contamination can acts as a sintering aid in these alloys but still conducting to advanced microstructures and superior performance than as-cast RHEAs. At the same time, the article reaffirms the possibility to produce fully-dense RHEAs parts with reduced density and ultrafine-grained microstructures by means of the optimization of the operational conditions for mechanical alloying and spark plasma sintering techniques. Lastly, the present work contributes to a better understanding of the complex composition-microstructure-properties relationship of these relatively new advanced materials.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M42
ID : 6281796

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** High Temperature Materials

Author : Dr Vives Solange (Aubert & Duval, France)

Co-author(s) : Ing Peachey Dominic (Alloyed, United Kingdom); Ing Hussain Zara (Alloyed, United Kingdom); Dr Németh André (Alloyed, United Kingdom); Dr Crudden David (Alloyed, United Kingdom)

Title : ABD®-1000AM: A Highly Processible Superalloy For Additive Manufacturing, Computationally Designed For 1000°C Applications

Keyword(s) :
Additive Manufacturing, Nickel-based Superalloys, ABD®-1000AM, Computational Design

Abstract :
The evolution of additive manufacturing (AM) has sparked a growing interest in using nickel-based superalloys, particularly for high-temperature applications above 1000°C. Traditional alloys, intended for casting or wrought processes, face challenges in AM due to the rapid heating|cooling rates and multiple melt cycles, resulting in compromises to material performance or part design freedom. Here we introduce ABD®-1000AM, a novel high gamma prime nickel-based superalloy designed computationally using the Alloys-by-Design (ABD®) approach, tailored for high-temperature AM applications. ABD®-1000AM exhibits world leading performance in terms of both processing capability as-well-as high temperature mechanical and environmental performance at 1000°C. The study discusses the alloy design and development strategy, highlighting the trade-offs in key performance parameters and the intricate process-microstructure-performance optimization undertaken to achieve the alloy's exceptional creep resistance. Based on the insights gained the future direction of alloy development of superalloys for complex AM components is discussed.

Innovative Aspect(s) :
New alloy development for Additive Manufacturing: ABD®-1000AM; A high temperature nickel-based superalloy with high gamma prime content, computationally designed and exhibiting exceptionnal performance at high temperature.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M43
ID : 6281827

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** High Temperature Materials

Author : Dr Besharatloo Hossein (CIEFMA-UPC|Colfeed4Print, Spain)

Co-author(s) : Mr Zegai Ahmed (University of Sciences and Technology Houari Boumediene, Algeria); Prof Dr Llanes Luis (CIEFMA-UPC, Spain); Dr Chirico Caterina (ICV-CSIC, Spain); Dr Ferrari Begoña (ICV-CSIC, Spain); Dr Sanchez-Herencia Antonio Javier (ICV-CSIC, Spain)

Title : Effects Of Nickel Content And Sintering Methods On Microstructure And Micromechanical Properties Of WC|Ni Composites

Keyword(s) :

Abstract :
Powder composition and sintering process significantly influence the microstructure, phase composition, and mechanical properties of WC-based composites. The precise control of both chemical composition and sintering conditions is crucial for tailoring these materials to meet specific requirements across diverse applications, such as cutting tools, wear-resistant components, and various industrial uses.The study comprehensively assesses: I) the impact of varying nickel content, and II) the influence of sintering methods, including conventional and Spark Plasma Sintering (SPS), on the final microstructures and mechanical properties of the WC|Ni composites.In doing so, two sets of WC|Ni composites (containing 5 and 10 vol% Ni) were sintered using SPS and conventional methods. Microstructural analysis included FESEM and XRD, while micromechanical properties were evaluated with nanoindentation mapping in conjunction with statistical analysis for evaluating hardness and elastic modulus of each phase. This detailed examination contributes valuable insights for enhancing the microstructural design of WC|Ni composites.

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 PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M44
ID : 6281339

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** High Temperature Materials

Author : Dipl-Ing Ariza Enrique (RHP Technology, Austria)

Co-author(s) : Dr Neubauer Erich (RHP Technology, Austria); Dr Ing Scheerer Michael (Advanced Aerospace and Composites, Austria); Dr Ing Stelzer Nils (Advanced Aerospace and Composites, Austria); Dr Bača Ľuboš (Advanced Aerospace and Composites, Austria); Mr Curti Pier Paolo (RHP Technology, Austria)

Title : Improvement Of Thermal Mechanical Properties Of Inconel 718 Reinforced With Ceramic Particles Manufactured By Plasma Metal Deposition (PMD)

Keyword(s) :
Additive Manufacturing, Plasma Metal Deposition, Nickel Alloy, Mechanical Properties

Abstract :
Nickel superalloys due to their good thermal mechanical properties and corrosion resistance are widely used for high performance on high demanding applications and industries as space, aviation or (petro-) chemistry. Moreover, the processing of this material class is costly due to the raw material and problems related to traditional processing techniques as casting, forging or milling (hot cracking, porosity, work hardening or wear on milling tools).Within this study the alloy Inconel 718 is processed with Plasma Metal Deposition (PMD®), an additive manufacturing process with high deposition rates for large part production. Additionally, the alloy is reinforced with ceramic Al2O3 particles that improves the mechanical properties at high temperatures. The weldability is studied. To assess the performance test coupons are investigated and analysed with respect to the mechanical properties

Innovative Aspect(s) :
This work aims to demonstrate the use of the Plasma Metal Deposition as an additive manufacturing Direct Metal Deposition technology using nickel-chromium super alloys powder feedstock reinforced with ceramic particles and compare the thermal mechanical properties with thestandard alloy.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M45
ID : 6282505

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** High Temperature Materials

Author : Ing Masari Facundo (Universidad Carlos III de Madrid, Spain)

Co-author(s) : Prof Dr Torralba Castello Jose Manuel (IMDEA Materials Institute, Spain); Prof Dr Campos Gomez Monica (Universidad Carlos III de Madrid, Spain); Prof Dr Olsson Pär (KTH Royal Institute of Technology, Sweden); Prof Dr Szakalos Peter (KTH Royal Institute of Technology, Sweden)

Title : Corrosion Testing Of High-performance Stainless Steels In Liquid Lead

Keyword(s) :
FeCrAl Alloys, Oxidation, Molten Pb, Liquid Metal Corrosion, Alumina Forming Steels

Abstract :
The use of molten lead as a heat exchange fluid poses important critical issues, both in terms of corrosion resistance and creep resistance, due to the temperatures and structural stresses reached during operation. The objective of this work has been the investigation of the corrosion resistance and mechanical properties of new experimental compositions of alumina-forming stainless-steel candidates for these applications. The exposures to stagnant liquid lead were carried out for 500 and 1,000 hours, at temperatures of 550 and 650 °C, with controlled amounts of oxygen dissolved in the liquid lead. In comparison with the AISI 316L and T91 both tested as reference materials, the studied alloys showed promising corrosion behaviour and mechanical properties. According to these results, the proposed steels are appropriate for components that will operate in liquid lead at elevated temperatures without corrosion, while maintaining good mechanical properties.

Innovative Aspect(s) :
Over the past few decades, clean energy solutions have emerged that mitigate greenhouse gas emissions. This category of clean energy technologies includes concentrated solar power and next generation (Gen IV) nuclear reactors. Molten metal coolers with Pb or Pb.Bi are envisaged in both cases. The corrosive nature of liquid Pb is one of its main drawbacks. In most cases, steel is protected from corrosion by forming a chromia layer, but at high operating temperatures this is not a stable barrier. In many high-temperature and extreme environments, stainless steels that form alumina have shown superior corrosion resistance. Therefore, these types of alloys are often proposed as material solutions in many high temperature applications, leading to more efficient energy generation systems. This is what this work explores, researching a new family of steels capable of forming martensite that would improve upon the behaviour of the current ferritic candidates.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024 CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M46
ID : 6283346

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** High Temperature Materials

Author : Dr Vivès Solange (Aubert & Duval, France)

Co-author(s) : Dr He Yining (Alloyed, United Kingdom); Dr Zhang Pimin (Alloyed, United Kingdom); Mr Peachey Dominic (Alloyed, United Kingdom); Dr Clark John (Alloyed, United Kingdom); Ms Hussain Zara (Alloyed, United Kingdom); Mr Wagstaff Thomas (Alloyed, United Kingdom); Dr Nemeth André (Alloyed, United Kingdom); Dr Crudden David (Alloyed, United Kingdom)

Title : ABD®-1000AM: A Highly Processible Superalloy For Additive Manufacturing, Computationally Designed For 1000°C Applications

Keyword(s) :
Additive Manufacturing, Nickel-Based Superalloys, ABD®-1000AM, Alloys-by-Design

Abstract :
The evolution of additive manufacturing (AM) has sparked a growing interest in using nickel-based superalloys, particularly for high-temperature applications above 1000°C. Traditional alloys, intended for casting or wrought processes, face challenges in AM due to the rapid heating|cooling rates and multiple melt cycles, resulting in compromises to material performance or part design freedom. Here we introduce ABD®-1000AM, a novel high gamma prime nickel-based superalloy designed computationally using the Alloys-by-Design (ABD®) approach, tailored for high-temperature AM applications. ABD®-1000AM exhibits world leading performance in terms of both processing capability as-well-as high temperature mechanical and environmental performance at 1000°C. The study discusses the alloy design and development strategy, highlighting the trade-offs in key performance parameters and the intricate process-microstructure-performance optimization undertaken to achieve the alloy's exceptional creep resistance. Based on the insights gained the future direction of alloy development of superalloys for complex AM components is discussed.

Innovative Aspect(s) :
The evolution of additive manufacturing (AM) technology has sparked a growing interest in manufacturing components from nickel-based superalloys for progressively more demanding applications at ever increasing temperatures. A critical challenge has been the development of high volume fraction gamma prime (γ') strengthened alloys for AM, suitable for applications at temperature of 1000°C or higher, as these are generally considered 'non-weldable'. Due to the nature of the AM process with high heating and cooling rates and multiple melting and solidification cycles, legacy compositions designed with the intent for casting or wrought processes are difficult and often uneconomic to process by AM. This leads to compromises in material performance or part design freedom, limiting AM's potential to replace traditional manufacturing in the most demanding environments. In response to these challenges, this study introduces ABD®-1000AM, a novel high gamma prime Ni-based superalloy, specifically designed using the Alloys-by-Design computational approach to excel in high-temperature.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024 CONGRESS & EXHIBITION

Technical Programme Committee
8th of February 2024

MATERIALS

FUNCTIONAL MATERIALS

EPMA
european powder metallurgy association

EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M47
ID : 6222297

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic : Functional Materials**

Author : Dr Ferraiuolo Alessandro (Marcegaglia steel, Italy)

Co-author(s) : Dr Ferraiuolo Lorenzo (University of Trieste, Italy)

Title : Mathematical Modelling Of Zinc-Aluminium-Magnesium (ZAM) Powder Melting In Zinc Melts

Keyword(s) :
Zinc-Aluminium-Magnesium Alloys, Surface Engineering, Powder Melting

Abstract :
This paper present a standard mathematical model treating the Zinc-Aluminium-Magnesium powder melting in a new process representing the merging of 3 different mature processes: additive manufacturing, surface engineering and hot dip galvanising. The aim is to obtain quite new coating systems constituted of unconventional compositions, including high entropy alloys, and thermodynamic phases both stable and metastable according with the specific cooling rate conditions adopted. The proposed approach will be used to explore the possibility to produce steel coated products with significantly higher corrosion resistance property.

Innovative Aspect(s) :
The paper deals of a quite new process under developing in Marcegaglia steel. The concept is the combination of powder addition on a liquid zinc layer. The result is a process much more sustainable (less global CO2 emissions) with respect to conventional routes. Many new alloy system can be achieved with this approach. This concept was filed recently (2023) for a patent application.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M48
ID : 6277035

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic : Functional Materials**

Author : Dr Wimbert Lars (GKN Powder Metallurgy Engineering GmbH, Germany)

Co-author(s) : Mr Lindenau René (GKN Powder Metallurgy Engineering GmbH, Germany); Mrs Neumann Bettina (GKN Powder Metallurgy Engineering GmbH, Germany); Mr Schnaider Edwin (GKN Powder Metallurgy Engineering GmbH, Germany)

Title : Optimizing The Production Process Of NdFeB Magnets

Keyword(s) :
Permanent Magnets, Rare Earth Magnets, NdFeB

Abstract :
Permanent magnets and especially NdFeB (Neodymium Iron Boron) magnets are one of the most critical components in the global manufacture of modern electric motors. The production process of NdFeB magnets contains a large number of different procedures, all of which can have an influence on the properties of the end product. Although at first glance relatively similar to the classic PM process, the manufacturing route involves some special challenges that will be examined in more detail in this paper. Starting with the optimization of the hydrogen decrepitation of the base material this contribution will additionally describe the effect of different milling parameters on microstructure and magnetic properties, the procedure of dimensionally precise compaction and sintering of magnet preforms and the magnetic testing of finished magnets.

Innovative Aspect(s) :
The manufacturing process of NdFeB permanent magnets is a complex multi-step production route in which every step from melting to final heat treatment can have an impact on the final magnetic properties. The paper will provide an overview over the manufacturing process and will focus on some powder related process steps to explain the effects of different process parameters on the final magnet properties.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M49
ID : 6281383

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Functional Materials

Author : Mr Sota Muñoz Ángel (CEIT-BRTA, Spain)

Co-author(s) : Dr Burgos Nerea (CEIT-BRTA, Spain); Dr Martín Jose Manuel (CEIT-BRTA, Spain); Dr Zhukova Valentina (UPV|EHU, Spain); Dr Gonzalez Julián (UPV|EHU, Spain); Mr Ipatov Mihail (UPV|EHU, Spain); Mr Osinalde Mikel (ELESA, Spain)

Title : Maximization Of Magnetic Saturation And Permeability Of Amorphous Powder Cores

Keyword(s) :
Amorphous, Soft Magnetic Material, SMC, Core Loss, Density, High Pressure

Abstract :
This work focuses on the study of increasing magnetic properties of soft magnetic composites (SMCs) made of amorphous powder. Amorphous powder was produced by gas atomization and SMCs were made by coating particles with an epoxy resin and cold pressed. However, the use of a coating isolating each particle, together with the brittleness of the amorphous powder, leads to low density compacts, which reduces the saturation magnetization and permeability. To increase compact density, a bimodal mixture of particle size fractions at a specific volume percent that maximizes particles packing was used. Additionally, powder cores were consolidated under high pressures (1, 1.5 and 2 GPa) to maximize density. Nevertheless, high pressure induces large residual stresses which reduces soft magnetic properties and increases power losses. Residual stresses were reduced by subsequent annealing. Thus, magnetic properties and power losses were analysed as a function of pressure, particle size fraction, resin content and annealing.

Innovative Aspect(s) :
SMCs are growing in the market for electrical devices such as inductors and transformers due to their isotropic 3D-properties, high electrical resistivities and the possibility of produce complex shapes. These properties make SMCs a promising candidate to replace existing electrical steels and ferrites for medium and high frequency applications respectively. In addition, amorphous materials provide very soft magnetic properties due to the absence of a crystal lattice and a high electrical resistivity that reduce Eddy currents. However, amorphous SMCs have some drawbacks such as low compact density, magnetic saturation and permeability. In this work, new amorphous SMCs were produced by mixing two fraction of particle sizes and consolidated under high pressure (up to 2 GPa). In addition, it is studied magnetic properties and power losses of SMCs in function of the resin content, the compaction pressure, particle size fraction and stress relief.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M50
ID : 6281350

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Functional Materials

Author : Dr Cano Cano Santiago (Incus GmbH, Austria)

Co-author(s) : Mr Peritsch Paul (Incus GmbH, Austria); Dipl-Ing Bosters Johannes (Incus GmbH, Austria); Mr Anand Atul (Vienna University of Technology, Austria); Prof Dr Gierl-Mayer Christian (Vienna University of Technology, Austria); Dr Harakály György (Incus GmbH, Austria)

Title : Recent Advances Of Lithography-based Metal Manufacturing Of Copper

Keyword(s) :
Additive Manufacturing, Copper, Lithography-based Metal Manufacturing, Sinter-based Additive Manufacturing, Powder, Particle Size Distribution

Abstract :
The high thermal and electrical conductivity properties of copper positions it as the optimal choice for a diverse range of electronic, electrical, and energy components. In applications like thermal management, incorporating small and intricate copper structures enhances component efficiency due to an increased surface area. Lithography-based metal manufacturing (LMM) facilitates the production of such geometries in a flexible and scalable manner, thereby unlocking the potential for innovative commercial copper products. Nevertheless, several challenges need to be addressed to manufacture high-quality copper components, ranging from the selection of suitable materials to ensuring stability during production and developing optimal processing parameters. This study focuses on evaluating the feedstock properties and processability of copper powders from different sources using LMM. Finally, the properties of the sintered components are measured to assess their effectiveness in thermal and electrical management applications.

Innovative Aspect(s) :
As indicated in the abstract, lithography-based metal manufacturing (LMM) can unlock the production of several geometries not attainable until now; those geometries, combined with the high thermal and electrical conductivity of copper, can lead to components with much higher efficiency in sectors like electronics or transportation. Despite initial studies have evaluated the LMM of copper, many aspects need to be investigated before the production of high-quality components. Our study explores the LMM of copper powders from different providers, with different particle size distributions and quality. By evaluating effect of the powder on the feedstock properties, the processability by LMM and the final properties of the components, we provide the powder metallurgy community a reference for the powder selection for LMM and other sinter-based additive manufacturing processes. Moreover, preliminary designs will be presented to demonstrate the potential of copper LMM.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M51
ID : 6283253

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic : Functional Materials**

Author : Dipl-Ing Thomas Thomas (Fraunhofer IFAM Dresden, Germany)

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Title : Copper-Diamond Composite With Complex Shape By Gel Casting Plus Spark Plasma Sintering

Keyword(s) :
Powder Metallurgy, Copper Diamond Composite, Additive Manufacturing, Spark Plasma Sintering

Abstract :
The trend toward miniaturization in electronic packaging poses challenges in cooling and temperature control, limiting design and efficiency. To address this, interest is growing in complex-shaped packaging with enhanced thermal conductivity. Additive technologies actual work for metallic materials but face compatibility issues with complex composites like copper-diamond, known for its high thermal conductivity (up to 700 W|mK). This report details efforts to introduce copper-diamond composites to additive manufacturing through gel casting. Mixtures of copper and diamond powder (up to 60% diamond volume) underwent optimization for binder systems. Post-sintering using a modified spark plasma sintering process resulted in structures with thermal conductivities measuring 688 W|mK, 1.7 times that of pure copper. Copper-diamond composites offer a new class of 3D cooling structures, crucial for heat dissipation in microelectronics, power modules, charging infrastructure, and e-mobility.

Innovative Aspect(s) :
At present, the shaping of composite materials with high thermal conductivity such as copper-diamond composites is mainly limited to dense, simple shapes such as discs or plates. Complex shapes are essential for heat dissipation. Special pin and rib structures increase the cooling capacity. Due to the high particle load of the composite materials, conventional machining poses a major challenge. The solution of shaping complex moulds using additive manufacturing and sintering them accordingly will further increase the performance of the cooling elements. At the same time, miniaturisation and weight reduction can be tackled.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024

CONGRESS & EXHIBITION

Technical Programme Committee

8th of February 2024

MATERIALS

LIGHT MATERIALS

EPMA

european powder metallurgy association

EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M52
ID : 6274677

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Light Materials

Author : Dr Kairet Thomas (Sirris, Belgium)

Co-author(s) : Dr Hemberg Axel (Materia Nova, Belgium); Prof Godet Stéphane (Université Libre de Bruxelles, Belgium); Dr Malet Loïc (Université Libre de Bruxelles, Belgium)

Title : L-PBF Printing Of 7075 Aluminium Powder Modified Using A Pure Ti PVD Coating : In-situ Micro-alloying

Keyword(s) :
Aluminium 7075, L-PBF, PVD Coating, Modified Powder

Abstract :
7075 aluminium alloys are common in the aerospace industry and are impossible to print on L-PBF due to there hot cracking sensitivity. The approach in this paper shall be to use the Ti PVD coating to add in the grain refiner in the meltpool and the microstructure shall be investigate in terms of mechanical properties, presence of defects, the impact of standard heat treatment. SEM investigations, Optical microscopy and tensile testing shall be used to show how the coating affects the solidification process. The impact of the coating shall have an impact on powder dynamics and rheological behaviour.

Innovative Aspect(s) :
Most strategies to print 7075 imply add in a grain refiner as a powder with issue of spreadability and homogeneity with the bulk base alloy. The use of PVD coatings on the powder overcome the issues of spreadability and homogeneity.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M53
ID : 6278391

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Light Materials

Author : Dipl-Ing Staufer Ella (RHP Technology, Austria)

Co-author(s) : Prof Dr Edtmaier Christian (TU Wien, Austria); Dr Horky Jelena (RHP Technology, Austria); Dr Klein Thomas (Light Metals Technologies, Austria); Dr Zhang Duyao (RMIT, Australia); Prof Dr Easton Mark (RMIT, Australia); Dr Schmitz-Niederau Martin (voestalpine Böhler Welding Germany, Germany); Miss Ballok Elisabeth (TU Wien, Austria)

Title : Development Of High Strength Ti-Cu Based Alloys With Equiaxed Grain Growth Produced Via Plasma Metal Deposition For Aerospace Applications

Keyword(s) :
Titanium Alloys, Material Characterisation, Mechanical Properties, Additive Manufacturing

Abstract :
The growing demand for titanium alloys, particularly in the aerospace industry, arises from their remarkable strength-to-weight ratio. However, the commonly used Ti-6Al-4V (Ti64) alloy exhibits columnar grain growth after additive manufacturing (AM), such as powder bed fusion (PBF) or direct energy deposition (DED), resulting in anisotropic mechanical properties. To overcome this, Ti-Cu-based alloys were introduced for equiaxed grain growth, but their mechanical properties fell short of Ti64. Ternary and quaternary alloying elements (Fe and Cr) were incorporated to enhance mechanical properties. Firstly, several alloys (Ti-6.5Cu-xCr-yFe) produced via powder hot-extrusion exhibited promising microstructure under light microscopy and SEM. Hardness and tensile strength were improved, even exceeding the tensile strength of Ti64. The most promising ones underwent the blown-powder Plasma Metal Deposition process (PMD) for in-situ alloying, revealing fine microstructures, equiaxed grains, and increased tensile strength. These findings highlight their potential for aerospace applications, presenting enhanced isotropic mechanical properties

Innovative Aspect(s) :
As additively manufactured Ti-parts are not available for thermomechanical heat treatments, it is important to produce equiaxed grain growth right after additive manufacturing in order to receive isotropic properties. The main goal of this work was to develop a Ti-based alloy with isotropic properties and mechanical properties matching the ones of the standard alloy Ti-6Al-4V. The results show that two alloys result in equiaxed grain growth after a blown-powder Plasma-Metal-Deposition process and exceed the mechanical properties of Ti-6Al-4V. With these new alloys, the material yield of titanium alloys can be increased as the material consumption can be reduced in comparison to traditional forging methods.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M54
ID : 6278385

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Light Materials

Author : Dr Ing Chouket Ameur (MINES Paris, PSL* Research University - CEMEF, France)

Co-author(s) : Prof Lahouij Iméne (MINES Paris, PSL* Research University - CEMEF, France); Dr Chmielowski Radoslaw (IMRA Europe S.A.S., France); Dipl-Ing Delatouche Bruno (IMRA Europe S.A.S., France); Dr Ing Pradille Christophe (MINES Paris, PSL* Research University - CEMEF, France); Prof Montmitonnet Pierre (MINES Paris, PSL* Research University - CEMEF, France)

Title : Tribo-mechanical Performances Of Ti3C2Tx MXene Flakes Reinforced Magnesium Alloy Composites

Keyword(s) :
Mg alloy Matrix Composite, MXene Flakes, 2D Materials, Mechanical Properties, Spak Plasma Sintering

Abstract :
MXenes a novel class of 2D metal carbides and nitrides, have emerged as promising materials for reinforcing lightweight alloys owing to their excellent mechanical properties. The efficiency of MXene in enhancing the mechanical strength of metallic composites is influenced by the employed manufacturing methods and their ability to design highly dense and uniform composites. In this study, we utilised the spark plasma sintering process to fabricate AZ91 composites reinforced with Ti3C2Tx MXene flakes. Achieving a uniform dispersion of the powder was a key objective, ensuring that MXene particles completely coat the AZ91 powder grains. The interface bonding of the two phases of the manufactured samples was then analysed through FIB cross-sectioning for different set of MXene fractions. The effect of Ti3C2Tx incorporation on the mechanical strength, ductility and failure mechanisms of the composites was assessed through uniaxial compression tests. The tribological properties were investigated via in situ SEM scratch experiments.

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 PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M55
ID : 6278426

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic : Light Materials**

Author : Dr Ing Rommel Daniel (GE Additive, Germany)

Co-author(s) : Dr Ing Schunk Christopher (GE Additive, Germany); Mr Wielenberg Christoph (Premium AEROTEC, Germany); Mr Palm Frank (Airbus, Germany)

Title : Investigation Of High-Productivity Parameter Sets For L-PBF Of Next Generation Al-Sc-Alloy

Keyword(s) :
High-Strength Aluminum, L-PBF, Al-Sc-Alloy

Abstract :
A next generation Al-Sc-alloy (Scancromal® (Al-Cr-Sc-Zr)) was printed using L-PBF technology. Compared to the more familiar Scalmalloy® (Al-Mg-Sc-Zr-Mn) the new material concept Scancromal® offers several advantages regarding process stability. Focus of the investigation was to explore the potential of such tailored alloy regarding maximum productivity utilizing increased layer thickness and laser power.Processing windows for two build layer thicknesses: 50 and 100 µm and two laser powers: 370 and 740 W were explored in order to identify parameter combinations to create dense (high strength & ductile) material and at the same time achieving highest build rates. The most promising combinations were down selected to print additional samples for microstructural and mechanical characterization. Samples were analyzed in "as printed" and heat-treated states to enable conclusions regarding processing parameters and resulting microstructure in addition to mechanical properties. Therefore, tensile properties were evaluated at room and elevated temperature.

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 PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M56
ID : 6281344

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Light Materials

Author : Prof Dr Bengtsson Sven (Höganäs AB, Sweden)

Co-author(s) : Dr Riabov Dmitri (Höganäs AB, Sweden)

Title : Optimized Heat Treatment Process Of Al-Mn-Cr-Zr Alloys Printed By Powder Bed Fusion - Laser Beam

Keyword(s) :
PBF-LB, Al-Mn-Cr-Zr Alloy, Heat Treatment, Mechanical Testing, Ductility

Abstract :
Additive manufacturing by powder bed fusion – laser beam process can produce parts with complex geometry and good mechanical strength. However, most conventional alloys with higher strength are not very well suited for the AM process, which has led to the development of new alloy systems. The newly developed Al-Mn-Cr-Zr alloy requires an aging process step after printing where several types of precipitates are formed. This is the main contributor to the strength of this alloy system. Ultimate tensile strength and Yield Strength reach good levels while ductility is on the low side compared to wrought materials in the same performance regime. In the present work tensile test bars were aged at 375 oC for different lengths of time. The response in terms of tensile test data, fracture surface appearance and microstructure are discussed in the paper.

Innovative Aspect(s) :
The major innovative aspect is trying to optimize the heat treatment to improve ductility instead of hardness | UTS. Also an innovative aspect is trying to modify the print procerss to ensure that a microstructure is formed that does not limit the ductility.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M57
ID : 6282466

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic : Light Materials**

Author : Ms Goettgens Valerie (University of Innsbruck, Austria)

Co-author(s) : Prof Dr Leichtfried Gerhard (University of Innsbruck, Austria)

Title : Influence Of Oxygen Scavenging On Mechanical And Microstructural Properties Of Additively Manufactured Titanium By The Addition Of Lanthanum Hexaboride

Keyword(s) :
Titanium Alloys, Laser Powder Bed Fusion, Additive Manufacturing, Alloy Development

Abstract :
In this work, commercially pure Ti was in situ alloyed in LPBF with 1 and 3 wt% LaB6 and TiB2, respectively, to study their influence on mechanical and microstructural properties. In samples where LaB6 was added an oxygen scavenging effect, associated with the precipitation of La2O3, and TiB formation was observed. In the case of TiB2 addition, TiB precipitates were found. Compared to TiB2, a lower hardness was observed in samples with LaB6. When 1 wt% LaB6 was added, the material showed a lower UTS than samples containing 1 wt% TiB2, but a similar elongation. The addition of 3 wt% LaB6 resulted in a decrease in UTS but an increase in elongation compared to 3 wt% TiB2.

Innovative Aspect(s) :
In titanium, interstitial oxygen increases the strength but reduces the elongation. If present in excessive amounts, it causes severe embrittlement. In LPFF, depending on the process atmosphere, the oxygen uptake in titanium can be tremendously increased due to the process characteristics. With the increase in interstitial oxygen in addition to embrittling martensite formation typically occurring in LPBF, producing crack-free parts with balanced tensile properties can be even more challenging. With the oxygen scavenging effect of lanthanum, excessive oxygen can be removed from interstitials during the process, associated with the formation of La2O3. Using this effect, a higher oxygen concentration in the process atmosphere in LPBF can potentially be tolerated, resulting in time and monetary savings.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M58
ID : 6281373

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Light Materials

Author : Dr Moser Mathias (ICB UMR 6303 CNRS | uB, France)

Co-author(s) : Dr Ing Ariane Mostapha (Sintermat, France); Mr Buisson Laurent (SATT Sayens, France); Mr Augustin Rémi (Safran Tech, France); Mr Sallot Pierre (Safran Tech, France); Prof Dr Bernard Frédéric (ICB UMR 633 CNRS | uB, France)

Title : Study Of The Change In Scale For The Sintering Of An Aluminium Alloy Powder By Spark Plasma Sintering

Keyword(s) :
Aluminum Alloy, Scale-up, SPS

Abstract :
Spark Plasma Sintering (SPS) technology is widely used to develop emerging materials with a fine and controlled microstructure. The main challenge for an industrial development of the process is to master the scale-up. From an SPS perspective, this requires suitable graphite tooling and a sintering cycle that can be applied to large-sized parts. Samples with diameters of 60 mm and heights of 10 mm were sintered from an aluminium alloy powder in order to reach an optimal densification and microstructure. Then, samples with diameters of 170 mm and heights of 15 mm were sintered. Characterisations and numerical simulation analyses were performed to determine the effects of the scale-up and to optimize the sintering conditions for obtaining dense and homogeneous materials

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 PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M59
ID : 6281669

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Light Materials

Author : Dr Ing Nidadavolu Eshwara (Helmholtz-Zentrum Hereon GmbH, Germany)

Co-author(s) : Dipl-Ing Wolff Martin (Helmholtz-Zentrum Hereon GmbH, Germany); Dr Ebel Thomas (Helmholtz-Zentrum Hereon GmbH, Germany); Prof Dr Willumeit-Römer Regine (Helmholtz-Zentrum Hereon GmbH, Germany)

Title : Effect Of Powder Surface Oxides In Ensuring A Reproducible Homogenous Microstructure In Powder Processed Mg-0.6Ca Alloy

Keyword(s) :
Magnesium-Calcium, Sintering, Grain Growth, Surface Oxides, Reproducibility

Abstract :
Abstract: Liquid phase sintered biodegradable Mg-0.6Ca alloy generally exhibits an isotropic microstructure with homogenously restricted grain size of 30 µm, even after long sintering durations of 60 h at 625 °C. Such sintered microstructures reveal the presence of numerous impurity oxide particles at the grain boundaries, which are evident also on the initial gas atomized powder surfaces. However, after a mechanical powder sieve treatment for 20 min, the surface SiO2 concentration dropped from initially 220 ppm to 85 ppm, resulting in heterogeneous grain coarsening after sintering for 18 h at 625°C. For the use of Mg-Ca materials as biodegradable implants, reproducibility of in vitro degradation results is a prerequisite, for which a homogenous grain structure is desired. However, the lowered oxide-pinning effect at certain grain boundaries created heterogeneous grain coarsening and this indicates the necessity for the careful handling of fine powders to ensure repeatability in degradation and mechanical properties.

Innovative Aspect(s) :
Magnesium and its alloy are regarded as potential candidates for orthopedic implant applications. Their mechanical properties match to that of human cortical bone and they degrade in physiological human body conditions eradicating the need for a second surgery. Addition of calcium to oxygen-sensitive pure magnesium innovates the fabrication of near-net shape magnesium materials by powder metallurgy route. Our previous results have shown that powder processed Mg-0.6Ca alloy exhibits a very low in vitro degradation rate nearing 0.3 mm|year until specimen porosities of 10%. A fine-grained homogenous microstructure is contributing to this reproducible degradation behavior. A similar microstructure is evident in additively manufactured viz 3D printed magnesium materials which innovates further the tailoring of material degradation and mechanical properties to suit patient-specific bone fracture needs.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : P-M60
ID : 6278611

Requested presentation type : Poster Presentation

Topic : Materials **Subtopic :** Light Materials

Author : Dr Ing Chouket Ameur (MINES Paris, PSL* Research University - CEMEF, France)

Co-author(s) : Prof Montmitonnet Pierre (MINES Paris, PSL* Research University - CEMEF, France); Ing Frances Krystal (IMRA Europe S.A.S., France); Dr Ing Pradille Christophe (MINES Paris, PSL* Research University - CEMEF, France); Dr Chmielowski Radoslaw (IMRA Europe S.A.S., France); Prof Lahouij Iméne (MINES Paris, PSL* Research University - CEMEF, France)

Title : Investigation Of Microstructures And Mechanical Properties Of AZ91 Magnesium Alloy Reinforced By Layered Ti3AlC2 MAX Phase

Keyword(s) :
Mg alloy Matrix Composite, MAX Phase, SPS, Microstructure, CompressionTests

Abstract :
Magnesium and its alloys seem to be the most promising and next generation material in transportation sector due to its high specific strength, good castability and low density. In this study, magnesium alloy (AZ91) metal matrix composites (MMCs) reinforced with 0-30vol% of Ti3AlC2 MAX phase were prepared by Spark Plasma Sintering (SPS) from powders at temperature close to the solidus. Ti3AlC2 has been previously synthesized using insulated SPS technology. Sintered composites reached quasi-full density. Their microstructure has been assessed by SEM and X-ray diffraction (XRD) respectively. Mechanical properties in relationship with the microstructure of all composites were carefully investigated. Vickers hardness (HV5), ultimate compressive strength (UCS) and conventional yield strength (0.2%YCS) increase with an increasing fraction of Ti3AlC2 in the composites and compare favorably with literature. SEM observations of fracture surfaces after compression tests seem to show that cracks initiate in both Ti3AlC2 clusters and a-Mg|MAX interfaces.

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 PM2024

CONGRESS & EXHIBITION

Technical Programme Committee

8th of February 2024

MATERIALS

NON FERROUS MATERIALS

EPMA

european powder metallurgy association

EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M61
ID : 6274499

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Non Ferrous Materials

Author : Mr Nassuato Mirko (Pometon SpA, Italy)

Co-author(s) :

Title : New Developments On The Formulation Of Pure Copper Premixes For The Production Of Parts For E-Vehicles And Electronic Applications

Keyword(s) :
EV Sintering Parts, Pure Copper for Classical Sintering, New Applications for Pure Copper Powder, Bus Bars Production, Electrical Components

Abstract :
Thanks to its high electrical conductivity, durability and malleability, copper is widely used for EV and for electronic components. EV use more than double the copper of an internal combustion engine automobile and it is also used heavily in EV-infrastructure like charging stations and in electrical grid infrastructure. Sintered Copper components could be part of the transition from combustion to electric engine and EV revolution. Pometon, by the experience on production of ECP and WA copper, continues to develop improved ready to press products to meet the needs of the classical sintering production process for the fabrication of copper components. This new study shows the developing of a high purity and highly densifying copper powders in particular improving the usage of the Premixes (flowability, comprimibility and dimensional changes) and the conducibility of the sintered parts to obtain the chemical, physical and mechanical characteristics needed for E-automotive and electronic applications.

Innovative Aspect(s) :
Massive usage of the pure copper premixes (new product) in the classical sintering (old technology) for EV applications (new application). Find the right compromize between usage of high purity powder (flowabiltiy, compressibility and dimensional changes) and electrical consucibility|mechanical properties of the sintered parts.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M62
ID : 6280917

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Non Ferrous Materials

Author : Mr Lin Hsuan Min (National Sun Yat-sen University, Taiwan)

Co-author(s) : Prof Kuo Che Nan (National Sun Yat-sen University, Taiwan)

Title : Microstructure Evolution Of Cu-based Metallic Glasses Between Different Scanning Strategies By Laser Powder Bed Fusion

Keyword(s) :
Cu-based, Bulk Metallic Glass, Scanning Strategies

Abstract :
Additive manufacturing (AM) technologies such as Laser Powder Bed Fusion (LPBF) enable Bulk Metallic Glasses (BMGs) production by exploiting high cooling rates and small-scale molten pool characteristics. LPBF theoretically offers ideal conditions, but challenges remain. Densification is affected by laser power, scanning speed, hatch distance, and layer thickness, nevertheless, among the stacked molten pool, the reheating situation between them resulted in heat affected zone (HAZ), causing amorphous-to-crystalline transformation.To overcome these processing disadvantages, a two-step scanning strategy, repetitive scanning, is proposed in this study. Initial low-energy-laser exposure forms an irregular porous structure, enhancing heat conduction, which is expected to minimize HAZ. Subsequent high-energy-laser exposure ensures complete melting. The study compares single and repetitive scanning strategies, analyzing phase formation, densification, microstructure, and micro-mechanical properties through XRD, DSC, SEM|EDS, and nanoindenter tests.

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 PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M63
ID : 6281709

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic : Non Ferrous Materials**

Author : Dr Panzeri Davide (Politecnico di Milano, Italy)

Co-author(s) : Prof Veronesi Paolo (Università degli Studi di Modena e Reggio Emilia, Italy); Prof Rivolta Barbara (Politecnico di Milano, Italy); Prof Gerosa Riccardo (Politecnico di Milano, Italy)

Title : Aging Treatment Of Selective Laser Melted Alloy 625: Mechanical Strength And Corrosion Resistance

Keyword(s) :
Superalloys, Alloy 625, Aging Treatment, Mechanical Property, Corrosion Resistance

Abstract :
Additive manufacturing is nowadays increasingly adopted to produce a large variety of components, especially with complex geometries. A deep investigation and optimization of the mechanical and corrosion performance of the selective laser melted Alloy 625 is extremely useful to support designers in the transition from the conventional to the additive manufacturing technology. Even though the selective laser melting technique is still associated with too high production costs and low productivity to enable a broader expansion, it permits to obtain excellent mechanical and corrosion properties compared to those of the conventionally manufactured alloy. Despite the additively produced material shows outstanding performance already in the as-built condition, aging treatments permit further strength improvement enabling possibility of reducing thicknesses, mass, resources consumption and environmental emissions. However, the balance between the mechanical and corrosion properties is critical and it requires a careful tuning of the heat treatment parameters.

Innovative Aspect(s) :
Nonstandard single- and double-aging treatments are investigated and optimized to permit further strength improvement and consequently reduce thicknesses, mass, resources consumption and environmental impacts.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M64
ID : 6281783

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Non Ferrous Materials

Author : Mr Delagnes Adrien (Université Paris-Saclay, CEA, Service de Recherche en Matériaux et procédés Avancés, France)

Co-author(s) : Dr de Carlan Yann (Université Paris-Saclay, CEA, Service de Recherche en Matériaux et procédés Avancés, France); Ms Hamann Clémence (Université Paris-Saclay, CEA, Service de Recherche en Matériaux et procédés Avancés, France); Prof Dr Bacroix Brigitte (CNRS, UPR 347, Laboratoire des Sciences des Procédés et des Matériaux, Université Sorbonne Paris Nord, France)

Title : Study Of The Nanoprecipitation Of Gamma' (Ni3Al) Phase In New Nickel-based Alloy For Molten Salt Reactors

Keyword(s) :
Nanoprecipitation, SPS, HIP, Nickel Based Alloy

Abstract :
Nickel-based alloys are attractive materials for nuclear industry and in particular for Molten Salt Reactors (MSR). They are especially considered for neutron reflectors or heat exchangers. These alloys have many advantages such as high mechanical properties at high temperature and good corrosion resistance in chloride salt. A new nuance for MSRs is being developed at CEA. This alloy is obtained after consolidation by SPS and by HIP treatment of powders obtained by atomization. To resist to irradiation, it is necessary to carefully control the nanoprecipitation in the material. This presentation aims to show that the use of different characterization techniques and in particular Small Angle X-rays Scattering (SAXS) makes it possible to specify the thermo-mechanical treatments to be carried out to obtain the desired state of precipitation in this new alloy.

Innovative Aspect(s) :
This material is a new innovant material for MSR developed to answer the challenges such as corrosion salt, irradiation damage and mechanicals properties.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M65
ID : 6282053

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Non Ferrous Materials

Author : Dr Kovacik Jaroslav (Łukasiewicz Research Network-Institute of Non-Ferrous Metals, Poland)

Co-author(s) : Dr Ing Kołacz Dariusz (Łukasiewicz Research Network-Institute of Non-Ferrous Metals, Poland); Dr Ing Lis Marcin (Łukasiewicz Research Network-Institute of Non-Ferrous Metals, Poland); Dr Ing Kulasa Joanna (Łukasiewicz Research Network-Institute of Non-Ferrous Metals, Poland)

Title : Microstructure And Compression Properties Of Cu-graphite Composites Prepared Via Spark Plasma Sintering

Keyword(s) :

Copper, Graphite, Composites, Spark Plasma Sintering, Compression Properties, Cross Properties, Electrical Conductivity

Abstract :
Mechanical properties of copper -graphite composites ought to be considered when designing their industrial applications in synergy with high electrical and thermal conductivity, low friction coefficient and coefficient of thermal expansion.Copper -graphite composites in range of 15-75 vol.% of graphite were densified using SPS technology at 900?. Microstructures confirmed certain anisotropy for prepared composites. Random orientation is in cross section perpendicular to applied pressure, aligned graphite is in cross sections parallel to applied pressure.Compression properties: 0.2% yield stress, compression strength, reduction of height and modulus of elasticity were determined. Compression properties of copper-graphite system are nonlinear on composition, with increasing graphite volume fraction they are decreasing.Fracture surfaces were investigated. At 15 vol.% of graphite fracture is via ductile tearing, with increasing vol.% of graphite, intergranular fracture takes place. Some cleavage fracture paths are partially observed. Finally cross properties of compression properties and electrical conductivity were investigated.

Innovative Aspect(s) :
Mechanical properties of copper-graphite composites are determined by properties of used materials, volume fraction of them and final composite microstructure. As copper and graphite do not react due to low solubility of them, their mechanical properties depend on the microstructure and mechanical properties of copper and graphite. The mechanical properties of copper -graphite composites ought to be taken into the account when considering their possible industrial applications in synergy with high electrical conductivity, high thermal conductivity, low friction coefficient and coefficient of thermal expansion.The innovative aspect of this work is to determine compression properties of copper -graphite composites prepared by SPS. This will enable to investigate the cross property connections between compression properties and electrical conductivity.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M66
ID : 6281565

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic : Non Ferrous Materials**

Author : Mr Mossop Theo (University College Dublin, Ireland)

Co-author(s) : Dr Celikin Mert (University College Dublin, Ireland); Dr Heard David (Stryker, USA); Prof Browne David (University College Dublin, Ireland)

Title : Anomalous Solidification Behaviour Of Ti-Nb-Ta Alloys Under Rapid Cooling Conditions

Keyword(s) :
Beta-Titanium, Rapid Solidification, Alloy Design, Solidification, Microsegregation, Ti-Nb-Ta

Abstract :
Processing ß-Titanium alloys via metal additive manufacturing (AM) have high potential to be used for biomedical applications, hence understanding their solidification behaviour under rapid cooling is critical.The solidification structures of Ti-Niobium-Tantalum (Ti-Nb-Ta) based alloys were investigated under various cooling rates using rapid solidification suction casting. An anti-solute trapping effect was determined for a ternary Ti-Nb-Ta alloy. In relatively slower cooled samples the microsegregation was in line with Scheil-Gulliver theory, however under more rapid cooling, the microsegregation increased significantly. In thermodynamically similar binaries, Ti-Nb and Ti-Ta alloys, typical solute-trapping effects were found, where the microsegregation tended towards unity with a reduction in casting diameter.The anomalous microsegregation had the effect of stabilizing additional ß-phase content of the as-solidified ternary alloy – reducing the otherwise favoured martensitic a" content and resulting in a dual-phase structure where the dendrites are primarily ß-phase and the interdendritic regions are a" martensite.

Innovative Aspect(s) :
The high-cooling rate solidification of AM-alloys is integral to the adoption of the technology. This work illuminates fundamental knowledge gaps in the microstructure evolution of beta-Ti alloys under rapid solidification conditions. This work also shows how this can have macroscopic effects on as-cast parts through alteration of the phase content beyond what is predicted by thermodynamic modelling. Detailed understanding of the microstructural evolution under rapid cooling will support studies on novel Ti alloy design for AM and other rapid solidification technologies, as well as will improve post-processing heat treatment methods.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024

CONGRESS & EXHIBITION

Technical Programme Committee

8th of February 2024

MATERIALS

OTHER PM MATERIALS

EPMA

european powder metallurgy association

EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M67
ID : 6265975

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Other PM Materials

Author : Mr Saviot Adrien (Laboratoire ICB, France)

Co-author(s) : Dr Le Gallet Sophie (Laboratoire ICB, France); Prof Sallamand Pierre (Laboratoire ICB, France); Prof Jouvard Jean Marie (Laboratoire ICB, France)

Title : Influence Of Powder On Phase Transformation In AlCoCrFeNi High Entropy Alloy Obtained By SPS

Keyword(s) :
AlCoCrFeNi, SPS, Phase Tranformation, Microstructure

Abstract :
The study focuses on AlCoCrFeNi high entropy alloy, known for its mechanical and high-temperature properties. While conventional melting processes of the equimolar AlCoCrFeNi composition result in a brittle material with a BCC|B2 spinodal microstructure, powder metallurgy offers the potential for additional phases and microstructures, that can lead to new properties. Pure elemental mixture powders and pre-alloyed powders were investigated, with mechanical activation or annealing at 1000°C. Both favored the formation of FCC phase over BCC, with annealing having a more pronounced impact. Spark Plasma Sintering at temperatures up to 1100°C further promoted FCC phase formation or BCC|FCC transition, primarily located at the prior particle boundaries or grain boundaries. Sigma phase precipitation was also observed out of its stability range due to the cooling rate. The study also explored the influence of SPS parameters, including pressure, heating rate, and dwell time, on phase transformations.

Innovative Aspect(s) :
There are several papers about sintering of this HEA but the obtained alloys present high hardness and low ductility. Here we analyzed the influence of all SPS parameters and initial powder influence (phases, microstructures). Influence of treatments like ball milling and annealing on initial powder was also investigated. According that, the objective is too define new parameters for AlCoCrFeNi sintering in order to promote the formation of FCC phase to improve its mechanical properties. A special attention has also been paid on the phenomenons at prior particle boundaries. Currently no published paper investigate this aspect.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M68
ID : 6277178

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Other PM Materials

Author : Dipl-Ing Guy Emilien (CEA Saclay, France)

Co-author(s) : Dr Malaplate Joël (CEA Saclay, France); Dr Guillou Raphaëlle (CEA Saclay, France); Prof Dr Boulnat Xavier (INSA Lyon, France); Prof Dr Perez Michel (INSA Lyon, France)

Title : Influence Of C Content On Microstructural And Mechanical Properties Of 14Cr ODS Ferritic Steels

Keyword(s) :
Oxide Dispersion Strengthened Steel, Coarse Precipitation, Carbides, Toughness, Creep

Abstract :
ODS (Oxide Dispersion Strengthened) steels have been developed as candidate materials for cladding in 4th generation fast neutron nuclear reactors for their oustanding performances. Nanoprecipitation has been the most studied part of these alloys, but coarse precipitation is known to have a detrimental effect on impact properties by occuring at grain or prior powder boundaries.Two ODS 14Cr ferritic steels with different C content (220 ppm vs 700ppm) were elaborated using Mechanical Alloying (MA) techniques, including ball milling with Y2O3 and TiH2 powders, followed by a final HIP treatment. Microstructure was characterized using SEM, XRD and SAXS, while mechanical properties were determined by impact toughness, creep and tensile tests.Whereas microstructure and nanoprecipitation are similar in both materials, coarse precipitation of Cr-rich carbides occurs only in high C content alloy. This alloy has higher creep failure time and DBTT, whereas USE (Upper Shelf Energy) is lowered

Innovative Aspect(s) :
Nanoprecipitation control and innvovation is nearly achieved in ODS ferritic steels for Sodium Fast Reactors. While coarser precipitation is likely to occur in the matrix, it is possible to reduce as much as possible their effect on properties. In this study, the challenge was to avoid element contamination (especially C and N pollution) from all steps, including powder atomization, ball milling and consolidation. N pollution was limited by working with powder under vacuum or Ar flushing. Then, making the comparison between a low carbon alloy and a more conventionnal carbon content alloy is possible, attributing effects on carbides precipitation and C presence in the matrix.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M69
ID : 6281002

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Other PM Materials

Author : Ms Şahin Gül Çağrı (Istanbul University - Cerrahpasa, Turkey)

Co-author(s) : Ms Temiz Cihan (Istanbul University - Cerrahpasa, Turkey); Prof Dr Mutlu İlven (Istanbul University - Cerrahpasa, Turkey)

Title : Production And Nondestructive Characterization Of Novel High Entropy Alloys

Keyword(s) :
Novel High Entropy Alloys, Powder Metallurgy Method, Non-destructive Tests, Military Applications

Abstract :
In this study, novel high entropy alloys have been produced by using mechanical alloying-powder metallurgy method. The high entropy alloys were produced for military applications. Initially, metal powders were prepared by mechanical alloying in a ball mill by using 6 mm zirconia balls for 15-20 hours at 400 rpm. Then, the high entropy alloy powder mixtures were compacted at about 400 MPa pressure in a hydraulic press, and then the green specimens were sintered in a vacuum environment at a temperature of 1250 °C for 1 hour in a horizontal tube furnace. Properties of the high entropy alloys were studied by nondestructive eddy current test and ultrasonic test. Elastic modulus of the sintered high entropy alloys was characterized by destructive compression tests and non-destructive ultrasonic tests comparatively. Effect of the mechanical alloying process parameters was determined.

Innovative Aspect(s) :
The high entropy alloys specimens were manufactured by mechanical alloying-powder metallurgy method. The casting based methods are not suitable to obtain a homogenaeous compositions because of the segregation due to the density differences of the alloying elements. High entropy alloys was usually prepared by casting. Due to the wide range of alloying elements, it is difficult to obtain high entropy alloys with uniform composition. Although there are several studies on the high entropy alloys, there are very limited studies on the effect of the mechanical alloying process parameters.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M70
ID : 6281334

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Other PM Materials

Author : Mr Belei Carlos (RHP-Technology GmbH, Austria)

Co-author(s) : Dr Kovacova Zuzana (RHP-Technology GmbH, Austria); Mr Bieg Johannes (ESA|ESTEC, Netherlands); Dr Neubauer Erich (RHP-Technology GmbH, Austria)

Title : Hot Pressing Process Optimization Of High Entropy Alloys Using Elemental Powder Mixtures

Keyword(s) :
High-Entropy Alloys, Hot Pressing, Elemental Mixtures

Abstract :
This study investigated the hot pressing of three distinct high entropy alloy (HEA) powder compositions, namely CrMo0.5NbTa0.5TiZr (named HEA-01), AlCrMoNbTi (HEA-02) and AlCrFeNiTi (HEA-03). The experimental design focused on varying temperature and dwell time, while pressure remained constant. Density was adopted as a response, which was assessed through both quantitative (using Archimedes density test with theoretical densities as a reference) and qualitative analysis (via microstructural examination). Subsequent hardness testing was also performed. It was observed that for HEA-01 and 03, fully-dense parts were achieved in conditions where reactions between the constituents occurred, which resulted in squeezing phenomenon during pressing. HEA-02 achieved densities above 99% without major squeezing or melting being reported. In any case, the observed microstructure was considered heterogeneous. Depending on processing conditions, HEA-01 and HEA-02 reached hardness values of 300 ± 11 and 298 ± 33 HV10, respectively, while HEA-03 was measured at 497 ± 23 HV10.

Innovative Aspect(s) :
This work combines hot pressing of High-Entropy Alloys (HEA's) — which has not been not as abundantly reported as other processing routes (such as e.g. arc melting) — and novel HEA powder compositions, different from the ones that are mostly reported (such as Camntor alloy, Senkov alloy, etc.).

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M71
ID : 6282478

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Other PM Materials

Author : Dr Cornide Juan (Complutense University of Madrid, Spain)

Co-author(s) : Ing Cuenca Fernandez Daniel (Complutense University of Madrid, Spain); Dr Encinas García, Noemí (Complutense University of Madrid, Spain); Dr M. Isabel Lasanta Carrasco (Complutense University of Madrid, Spain); Dr Alcalá Penades Germán (Complutense University of Madrid, Spain); Dr Frutos Torres Emilio (Complutense University of Madrid, Spain)

Title : Influence Of Cr|Ni Ratio On The Formation Of C14 Phases In A Ti7Nb6Cr(4-x)Ni(1+x)VAl Refractory High Entropy Alloy

Keyword(s) :
Refractory High Entropy Alloys, Powder Metallurgy, Hydrogen Storage

Abstract :
Refractory Eutectic High Entropy Alloys (RHEAs) with body-centered cubic (BCC) single-phase structures have attracted extensive attention in hydrogen storage due to their unique structural characteristics and excellent performance. A general observation shows that BCC structures form more stable hydrides than Laves phase-based hydrides. In the present study, several Ti7Nb6Cr4-xNi1+xyVAl (x=0,1,2) RHEAs obtained by high-energy mechanical alloying were investigated to understand the influence of the Chromium|Nickel ratio on the transition from BCC and C14 Laves phase into a single BCC phase. The research was conducted through SEM and X-ray diffraction analysis. Additionally, several thermodynamic parameters such as the enthalpy of mixing (?Hmix), size difference (d), valence electron concentrations (VEC), and electrons per atom ratio (e|a) have been correlated with the experimental data.

Innovative Aspect(s) :
For the potential use of HEAs in hydrogen storage, it will be necessary to balance the stability of BCC-C14 Laves phases, as the BCC structures enhance hydrogen storage while the C14 phases increase the performance of absorption|desorption cycles. Therefore, the present study will provide important insights for the future development of HEAs in hydrogen storage technology.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2024
CONGRESS & EXHIBITION
Malmö, Sweden
29 September - 02 October 2024

Paper Number : M72
ID : 6282843

Requested presentation type : Oral Presentation

Topic : Materials **Subtopic :** Other PM Materials

Author : Dr Ing Fortini Annalisa (University of Ferrara, Italy)

Co-author(s) : Dr Ing Suman Alessio (University of Ferrara, Italy); Ms Vezzani Ottavia (University of Ferrara, Italy)

Title : Tribological Behavior Of Soft Magnetic Composite Materials In Lubricated Condition

Keyword(s) :

Abstract :
Soft magnetic composites (SMCs) have gained prominence for compact and powerful electromechanical systems, combining metallic functionality with the ability to generate a magnetic field autonomously. These materials, capable of generating a magnetic field without external supply, find applications in automotive and aerospace technologies to enhance power and withstand mechanical stress, reducing component count, size, and system weight. This study delves into the tribological behaviors of two SMC variants produced through powder metallurgy. Employing a tribometer in lubricated conditions per the ASTM G-99 standard, wear tests scrutinize the impact of oil temperature and applied load. Post-mortem analysis identifies the influence of oil viscosity on SMC operational life, with removal mechanisms contingent on load conditions. This research underscores the importance of judiciously selecting oil characteristics and load parameters to bolster SMC reliability and diminish maintenance requirements.

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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