EURO PM2023
CONGRESS & EXHIBITION

Technical Programme Committee
15th February 2023

ABSTRACTS BOOK – GROUP 4

CONSOLIDATION TECHNOLOGIES

AM beam based technologies

EPMA
european powder metallurgy association

EURO PM2023

CONGRESS & EXHIBITION

Technical Programme Committee
15th February 2023

CONSOLIDATION TECHNOLOGIES

AM BEAM BASED TECHNOLOGIES

EPMA
european powder metallurgy association

EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235734093

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Ms Mthembu Noluthando (Stellenbosch University, South Africa)

Co-author(s) : Prof Sacks Natasha (Stellenbosch University, South Africa)

Title : Process Development Of A Ti-6Al-4V-10wt%WC Metal Matrix Composite Using Selective Laser Melting

Keyword(s) :
Selective Laser Melting; Ti6Al4V; Metal Matrix Composite; Deposition Analyses; Tungsten Carbide

Abstract :
In this study the influence of laser power, scanning speed and hatch spacing was investigated on the development of a Ti-6Al-4V alloy reinforced with 10wt%WC to form a metal matrix composite. Response surface methodology was used for both the design of experiments and results analysis. The laser power was varied between 87 and 104 W, while scanning speed and hatch spacing were varied between 500 and 700 mm|s, and 77 and 94 µm, respectively. Cube samples were deposited using a continuous meander scanning pattern which was selected after initial optimisation of the Ti-6Al-4V alloy. Density, porosity, and Vickers micro-hardness were measured, while the microstructure was studied using x-ray diffraction, scanning electron microscopy and energy dispersive spectroscopy. Properties were measured in both the transverse and longitudinal directions, and relationships established with the deposition parameters in order to find the optimal deposition parameters for the composite.

Innovative Aspect(s) :
The addition of tungsten carbide (WC) particles to a Ti-6Al-4V alloy to form a metal matrix composite using laser powder bed fusion is new. The carbides are being added to improve the strength and wear properties of the titanium alloy.

Reviewer's name : ……

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : ……

Notes to author : ……

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EURO PM2023 CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235735468

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Dr Botero Carlos (Mid Sweden University, Sweden)

Co-author(s) : Mr Sjöstrom William, Mr Jiménez-Piqué Emilio, Mr Şelte Aydin, Dr Rännar Lars-Erik (Mid Sweden University, Sweden)

Title : E-PBF For Manufacturing Of 3D Metal-metal Multi Material Assemblies

Keyword(s) :
Multimaterials; E-PBF. Tool Steels; Stainless Steels

Abstract :
Most Powder Bed Fusion (PBF) methods for the Additive Manufacturing (AM) of metals are based on manufacturing components by the melting of powder feedstock of one kind; either of pure-elemental or pre-alloyed compositions. Although the AM of multi-materials has recently gained a lot of attention, it is still not commercially available for metal PBF. In the specific case of Electron-beam based PBF (E-PBF), it is possible to precisely control the beam parameters such as speed, spot size and current in each site of the build area. By doing this for each manufactured layer, the melting and solidification process can be steered throughout the build. This, together with the hot-nature of E-PBF occurring in a protective vacuum atmosphere, opens great possibilities for adaptive processes that allows melting of feedstock powders of different nature in the same build. In this investigation, different steel-based powders are used to create metal-metal multimaterial assemblies,

Innovative Aspect(s) :
The additive manufacturing (AM) of metal multimaterials is of great interest nowadays. Although the Powder Bed Fusion (PBF) technologies represent the largest portion of the metal AM market, the manufacturing of multimaterials by PBF is still not commertially available. In this work an innovative experimental setup is proposed for the E-PBF technology to achieve steel-based multimaterials in different layer assembies and configurations. The novel materials obtained and properties evaluated are promising in a wide range of applications.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235741167

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Dr Li Xiaoshuang (Aerosint SA, Belgium)

Co-author(s) :

Title : Multi-Material Laser Powder Bed Fusion Of Steels And Ni-based Superalloy

Keyword(s) :
Multi-Material LPBF; Superalloy; FGM

Abstract :
The invention of Selective Powder Deposition (SPD) enables creating a thin layer of multiple powders with customized patterns. Its successful integration into Laser Powder Bed Fusion (PBF-LB) machines opens the door to additive manufacturing of multi-material parts with not only geometry but also functionality complexity in 3 dimensions.The present work focuses on the combination of ferrous alloys and a high temperature Ni-based superalloy. Unique machine learning assisted Design of Experiment (DoE) was applied to accelerate the development of processing parameters for achieving high density as well as production speed. Special scanning strategies were introduced to ensure sound metallurgical bonding at the interface. The microstructure especially at the material interface was characterized using OM and SEM.

Innovative Aspect(s) :
1. Multi-material parts by fully automated LPBF
2. Function Graded Materials
3. For the first time, machining learning was introduced to speed up process development for multi-material LPBF.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235746744

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Mr Jabir Hussain Ahmed Fardan (Chalmers University of Technology, Sweden)

Co-author(s) : Dr Brodin Håkan (Siemens Energy AB, Sweden), Dr Hryha Eduard (Chalmers University of Technology, Sweden)

Title : PBF-LB|M Of A Non-weldable Ni-base Superalloy: Role Of Processing Parameters On Hot Cracking

Keyword(s) :
Superalloy; Non-Weldable; CM247LC; Hot Cracking; Solidification Cracking

Abstract :
Additive manufacturing of non-weldable CM247LC by powder bed fusion – laser beam of metals (PBF-LB|M) is challenging due to the high cracking susceptibility of the alloy. The objective of this study was to find a processing window that leads to dense parts with low porosity and crack density. A full factorial design of experiments (DOE) was done to study the influence of laser powder, scan speed, and hatch spacing on porosity and crack density. The obtained results show that minimal porosity and crack density was obtained for parameters with low hatch spacing and high scan speeds. The study shows that it is possible to print the so-called 'non-weldable' alloy with minimal defects.

Innovative Aspect(s) :
The innovative aspects include the effect of processing parameters on hot cracking and residual stresses. Residual stresses are often overseen in such crack sensitive materials which can be problematic in high gamma-prime stregnthened materials like CM247LC. This study tries to find a parameter with minimal defect s well as residual stress.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235761708

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Mr Özeren Emre (Tusas Engine Industries, Inc. (TEI), Turkey)

Co-author(s) : Mr Ünver Çaglar, Mr Bilgin Güner Mert, Mrs Ertekin Beyzanur, Mr Tas Alican, Mrs Cavcar Zehranur, Mr Gökcan Muhammed Baybars, Mr Orhangül Akin, Mr Dilektasli Emre (Tusas Engine Industries, Inc. (TEI), Turkey)

Title : Investigations Of Powder Reuse On Flowability And Mechanical And Metallurgical Behavior Of Alloy 718 For L-PBF

Keyword(s) :
Laser Powder Bed Fusion; Powder Reuse; Powder Characterization; Powder Rheology; Fatigue; Alloy 718

Abstract :
In L-PBF, metal powders are used as feedstock material and can be reused for successive productions. The reused powder usage requires attention in high-quality and reliable part production since the reused powder may affect flowability and built-part properties. In this study, Alloy 718 powder was produced over 40 series of L-PBF build cycles without rejuvenating the powder. The powder characterization was performed in order to investigate the flow behavior of reused powder using several methods. Besides, tensile tests, fatigue tests, Archimedes, and image processing density measurements were performed in order to investigate the behavior of built-part produced by reused powders. Furthermore, chemical composition analyses were carried out over both bulk and powder samples. The results showed that no significant and meaningful difference was seen among 40 cycles in some powder characteristics and built parts behavior while there are prominent differences in some powder characterization methods and in metallurgical behavior.

Innovative Aspect(s) :
Alloy 718 powder featured over 40 series of L-PBF build cycles with no rejuvenation. The powder characterization was performed in order to investigate the flow behavior of multiple times reused powders applying several methods such as powder rheology analysis with both shear and powder cell, particle size distribution (PSD), quantitative morphology analysis and Hausner Ratio calculation. Together with these, mechanical tests such as tensile and fatigue were performed on the reused cycles. Moreover, chemical composition analyses were performed on both powder and bulk samples. Since there are contradictory results in the literature and powder handling procedures vary from user to user, exploring of reused powder behavior requires more attention. This study aimed to help users to explore the reused powder behavior by reusing powder over 40 cycles using different methods with novel approaches. To the best of the authors' knowledge, there are no such reuse cycles performed in literature.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023 CONGRESS & EXHIBITION

01-04 October 2023

Paper Number : EP235762547

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Prof Dr Gromov Alexander (University of Ulsan, Korea, Republic of)

Co-author(s) : Prof Dr Kim Jin-Chun, Mr Cong Dinh Van, Mr Lee Dong Wan (University of Ulsan, Republic of Korea)

Title : Metal And Ceramic Nanopowders Application In Metal Matrix Composites Manufacturing By 3D Printing By Laser Powder Bed Fusion Technology

Keyword(s) :
Nanopowders; Additive Manufacturing; Laser Powder Bed Fusion; Aluminum Matrix Composites; Superalloys

Abstract :
The era of quality optimization for micron-sized spherical powders application in 3D Printing (Laser Powder Bed Fusion, LPBF) technology is on its fast development. However, for many applications the high level of mechanical properties for 3D printed metal-matrix composite materials was achieved by nano-metal and nano-ceramic additions to the metals|alloys matrix application. For example, in the case of oxide-dispersed-strengthened (ODS) superalloys or aluminum matrix composites (AMC) a strength and hardness of the nano-strengthened 3D materials could achieve 120-130 % in comparison with alloys|composites strengthened by micron-sized additives. In this work we summarized our experience in nano-ceramics and nano-metals (nAlN, nBN, nWC, nAl) applications at AMC as well as nano-ceramics (nAl2O3, nSiO2) application in Inconel by 3D printing (LPBF technology). The dependence of 3D samples properties from the composition of initial powdery mix and 3D printing regimes was comprehensively studied.

Innovative Aspect(s) :
The new effects on nano-strengthening of AMC and superalloys were studied. Phases segregation by melting pool solidification and in-situ or ex-situ mixing of metal matrix powders with metal and ceramic nano-additives play the crucial role in the mechanical characteristics of the 3D printing materials. Comprehensive experimental study of these phenomenas was executed and discussed in detail.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235782991

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Dr Ordas Nerea (Ceit-BRTA and Tecnun (Universidad de Navarra), Spain)

Co-author(s) : Ing Schiopetto Maria Flor, Ing Lopez-Lopez Josu, Ing Perez-Casero Iñigo, Dr Aristizabal Miren, Dr Veiga Angela, Dr Ausejo Sergio (Ceit-BRTA and Tecnun (Universidad de Navarra), Spain)

Title : Laser-Directed Energy Deposition Processing As A Tool To Repair Or Obtain Hybrid Complex-Shape Components

Keyword(s) :

Abstract :
Laser-Directed Energy Deposition offers the possibility to combine traditional and additive manufacturing processes, boosting the flexibility during repairing damaged parts and manufacturing of complex-shaped components.This work demonstrates the potential of powder L-DED as an effective tool in hybrid processes. Two use cases are presented. The first one is a mounting lug built with a Ni-base superalloy, Astroloy, on a turbine case of the same material, previously produced by PM-HIP (Hot Isostatic Press of encapsulated powder), for aero-engines. The second one refers to repairing of two railroad components, a rail of a pearlitic steel (R260), and a crossroad of a high Mn steel. Gas atomized powders are used in all cases, being the chemical composition for railway specifically designed for this application. L-DED parameters were selected to avoid defects like pores or cracks. Microstructural and mechanical characterization were performed to verify that the AM parts meet the required specifications.

Innovative Aspect(s) :
L-DED is a process of increasing interest in maintenance and repairing operations of parts of high complexity or difficult to repair, or where service suspension must be minimized, as occurs with railroad components. Moreover, when combined with conventional manufacturing technologies, it offers a number of benefits over L-DED or conventional approaches alone, like the possibility to enhance functionalities or reduce costs associated to material consumption or machining operations. Some of the advantages of the process presented in this work, compared to welding, are: (1) fewer substrate affection and residual stresses, thanks to the use of less energy, (2) feasibility to work with mixtures of powders, (3) possibility to control the process temperature during deposition by means of a pre-heating system to avoid phase transformations into brittle phases (like martensite in R260 steel), and (4) enhanced precision and reproducibility in the quality of the repairs or the complex subcomponents built.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235762584

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Dr Mancisidor Ane Miren (LORTEK, Spain)

Co-author(s) : Mr Gómez Raúl, Dr Dos Santos Rafael Eugenio, Ing Garciandia Fermin, Dr San Sebastián María, Dr Gil Emma (LORTEK, Spain)

Title : Cracking Susceptibility Assessment Of L-PBF CM247LC Alloy Based On Composition And Process Parameter Modifications

Keyword(s) :
LPBF; CM247LC; Cracking Susceptibility; Composition; Process Optimization; Metallographic Characterization

Abstract :
CM247LC alloy is a precipitation strengthened nickel-based superalloy commonly used in aeronautic sector due to its outstanding mechanical, oxidation, creep and wear properties at room and at high temperatures. However, there is a big challenge in obtaining a crack free material during L-PBF processing. High contents of Al and Ti induce cracking. Four batches of CM247LC powders with different compositions were analysed and processed by L-PBF. In this study, different approaches were employed to mitigate crack susceptibility of the alloy, namely, alloy modification, process modification and post-processing by HIP. The influence of the elements on cracking was assessed as well as the process parameters modification, including modification of the laser scanning strategies. Microstructure before and after post-processing, namely heat treatments and HIPping, was evaluated and cracking mechanism was studied in the light of microstructural observations.

Innovative Aspect(s) :
CM247LC is a nickel base super alloy used in aeronautical applications where the component should withstand harsh conditions. Thus, it is of great importance to achieve a defect free material. When processing CM247LC by L-PBF its chemical composition should be controlled in order to reduce the tendency to cracking. In this work, the alloying elements that have a higher influence in cracking during L-PBF process have been analysed. Moreover, process modification includes an innovative laser scanning strategy to reduce the microcrack density.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235762606

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Mr Venkatesh Kumaran S (IMDEA Materials, Spain)

Co-author(s) : Mr Malladi Sri Bala Aditya, Prof Dr Hryha Eduard (Chalmers university of technology, Sweden), Prof Dr Torralba José Manuel (Universidad Carlos III de Madrid, Spain)

Title : Effect Of Process Parameters And Heat Treatments On Non-equiatomic CoCrFeNiMoxAly HEAs Manufactured By PBF-LB|M Via In-situ Alloying

Keyword(s) :
Laser powder bed fusion, high entropy alloys, commercial commodity powders, annealing

Abstract :
Manufacturing high entropy alloys (HEAs) using powder bed fusion-laser beam|Metal (PBF-LB|M) enables their production with minimal elemental segregation due to its inherently fast cooling rates resulting in excellent properties. So far, HEAs have been fabricated with fully pre-alloyed gas-atomized powders which makes it expensive and slower to explore new alloy compositions. In this work, for the first time, instead of pre-alloying, blended powders of CoCrF75, Ni625, Invar36, and pure Al powders were used as feedstock to develop a CoCrFeNiMoxAly HEA which consists of FCC phase in the metastable state. The process was successfully optimized, achieving relative densities greater than 99.8%. Moreover, annealing at various temperatures and times is performed to study its effect on precipitating new phases such as BCC, sigma, and μ. This method of mixing powders for PBF-LB|M enables rapid exploration of new HEAs and this work is expected to contribute to its successful application in the future.

Innovative Aspect(s) :
Blending commercial commodity alloy powders with elemental powders to produce feedstock instead of fully pre-alloyed powders for powder bed fusion - laser beam|Metals (PBF-LB|M).
Lowering the cost of manufacturing High entropy alloys (HEAs) to enable their commercialization.
Studying the effect of SLM process parameters on homogeneity, cracking, and microstructure on Al and Mo-based dual-phase HEAs produced via in-situ alloying by mixing Al powders with commercial commodity powders containing Mo.
The use of powders of different densities is a challenge in powder bed fusion processes and this work studies the effect of lighter elements like Al on the homogeneity of the distribution of elements.
Studying the effect of heat treatments on the metastable microstructure obtained from PBF-LB|M to precipitate secondary phases.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023 CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235762610

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Dr Ing Vecchi Giuseppe (Politecnico di Torino, Italy)

Co-author(s) : Prof Atzeni Eleonora, Prof Iuliano Luca, Prof Salmi Alessandro (Politecnico di Torino, Italy)

Title : Control Of The Substrate Heating In Laser Powder Directed Energy Deposition Repairing By Bi-directional Spiral Deposition Strategy

Keyword(s) :
Directed Energy Deposition; Repairing; Thermal cycling; Deposition Strategy

Abstract :
Recent improvements in the Laser Powder Directed Energy Deposition (LP-DED) process for repair applications shift the focus to the analysis of possible alterations in the substrate, which is subjected to repeated thermal cycling during deposition of the material. In general, thermal loads can be controlled by changing process parameter. In this work, a two-step bi-directional spiral deposition strategy, alternating between deposition from inward to outward and backfill, is analyzed to evaluate the heating of the substrate and the resulting porosity of the added material. The outcomes indicate the potential of this strategy to control heat flow and achieve a more uniform thermal field. Porosity is minimized by optimizing the hatch spacing, and benefits are observed also in terms of top surface roughness.

Innovative Aspect(s) :
At the state of the art, research on LP-DED technology is focuses mainly on the properties of the deposited features and adhesion with the substrate. However, in repair applications, it is of paramount importance to preserve the microstructural properties of the substrate material, avoiding the creation of internal stresses and distortions. Attention to these aspects is the main innovative aspect of the work, in which an attempt is made to control the thermal loading of the substrate by managing the deposition strategy.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235762626

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Ing Felicioni Stefano (Politecnico di Torino, Italy)

Co-author(s) : Prof Padovano Elisa, Prof Marchese Giulio, Dr Quercio Michele, Prof Canova Aldo, Prof Biamino Sara, Prof Bondioli Federica (Politecnico di Torino, Italy)

Title : Optimization Of Process Parameters For CuCrZr Alloy Manufactured By Electron Beam Powder Bed Fusion Technology

Keyword(s) :
EB-PBF; Electron Beam Melting; Copper; CuCrZr; Additive Manufacturing; Topology Optimization

Abstract :
The CuCrZr alloys show advantageous mechanical properties and high electrical conductivity which make them promising for many applications in the electrical and aerospace engineering industries. Unfortunately, these two important properties are in opposition to each another; however, additive manufacturing technologies are good candidates to balance these two aspects to achieve high performance parts. The Powder-Bed-Fusion (PBF) techniques involve rapid heating and cooling rates which allow to obtain huge microstructural refinements, thereby improving the mechanical properties without any significant loss in the electrical conductivity. This study concerns the process parameter optimization for CuCrZr alloys produced by means Electron-Beam-PBF technology using a trial-and-error approach. The material was characterized by porosity analysis, tensile and electrical conductivity measurements. The effect of process parameters on microstructure and densification behavior was also investigated.This work was performed within the project "IMplementazione della Produzione Additiva CompetiTiva IMPACT co-financed by POR-FESR Piemonte 2014-2020".

Innovative Aspect(s) :
The present work concerns an innovative processing way for the CuCrZr alloy, allowing to enlarge the number and the effectiveness of its applications. It is widely known that this alloy is suitable in vacuum electronics, fusion energy research, and heat transfer systems. All the aforementioned implementations require very complex and time-consuming design optimizations; therefore, the possibility to remove geometrical constraints become crucial. The additive manufacturing makes it possible, and the Electron Beam-PBF is a very promising technology to process the materials, such as copper and its alloys, which show high reflectivity, leading to almost fully dense parts (>99.95%) free of internal stresses.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235762866

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Mr Paiotti M. G. Rafael (Metalpine GmbH, Austria)

Co-author(s) : Dipl-Ing Graf Eva, Dipl-Ing Arneitz Siegfried, Prof Dr de Traglia Amancio-Filho Sergio (TU Graz, Austria)

Title : A Printability Study Of In Situ Alloyed NiTi Shape Memory Alloy By Laser-powder Bed Fusion In Non-heated Ti Substrate Plate

Keyword(s) :
Laser Powder Bed Fusion; In Situ Alloying; Shape Memory Alloys; Niti; Nitinol; Cost Reduction; Versatility

Abstract :
NiTi is the most employed Shape Memory Alloy. The biomedical and aerospace sectors have successfully employed it because of its biocompatibility, functional shape memory, and superelastic effects. However, drawbacks, such as lack of machinability, have made additive manufacturing an alternative for processing NiTi. Laser powder bed fusion (LPBF) showed the feasibility of printing functional and defect-free NiTi parts using pre-alloyed powder as feedstock material. Nevertheless, due to its reactivity, this powder is challenging (thus costly) to atomize, thus hindering NiTi application. An alternative relies on in situ alloying, where elementally blended Ni and Ti powder is used to form NiTi locally. This work investigates the LPBF of Ni-rich Ni51(at%)Ti by in situ alloying built on a Ti plate without prior heating. Although in situ alloying of NiTi showed susceptibility to defects, it was possible to determine a process map to attain functional, defect-less parts on a non-pre-heated Ti substrate.

Innovative Aspect(s) :
For the first time, in situ alloyed NiTi was printed in a non-heated substrate Ti plate. It reduces the feedstock (in situ alloying) and operative (non-heated substrate plate) costs - by in situ alloying, it was obtained already Ni4Ti3 reinforced parts with superior mechanical properties if compared to the conventional use of pre-alloyed powdershis technique allows versatility to tailor the composition and well as the addition of ternary elements to change the properties in house.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235762947

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Ms Nilsson Åhman Hanna (Swerim AB, Sweden)

Co-author(s) : Ms Larsson Lisa, Dr D'Elia Francesco, Prof Persson Cecilia (Uppsala University, Sweden), Dr Mellin Pelle (Swerim AB, Sweden)

Title : Effect Of Part Thickness On The Microstructure Of A Mg-Y-Nd-Zr Alloy Processed By L-PBF

Keyword(s) :
L-PBF; Mg Alloys; WE43; Microstructure

Abstract :
Laser – powder bed fusion (L-PBF) of Mg-Y-Nd-Zr alloys enables the production of complex biodegradable orthopaedic implants, for patient-specific designs with enhanced biocompatibility. However, the effect of part geometry on the microstructure is yet to be investigated. Thus, here the microstructure in walls of varying thickness (0.2 mm to 3 mm) was investigated. It was found that for wall structures thinner than 1 mm, a significant amount of keyhole porosity was present, and a dendritic microstructure was primarily observed. For the thicker wall structures (> 1 mm), the dendritic structure was only present at the edges of the samples. In the bulk, a cellular structure with large basal grains was observed. The difference is microstructure was ascribed to the change in thermal conditions, a major factor being an increased insulating effect of the unmelted powder surrounding the samples.

Innovative Aspect(s) :
Mg and its alloys have been gaining increasing attention for its low weight and high biocompatibility in the last couple of decades. However, the research surrounding the processing of Mg alloys by L-PBF remains limited in general. Specifically, the relationship between process parameters, microstructure and material properties are largely unknown. Moreover, the influence of geometry has not been explored at all. This study highlights the importance of considering wall thickness when developing process parameters, especially for thinner structures. In turn, producing thinner structures is highly relevant for developing orthopedic implants, as lattice structures with relatively fine details are typically explored for that kind of applications.

Reviewer's name : ……

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : ……

Notes to author : ……

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235763233

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Dr Ing Pereira Juan Carlos (LORTEK, Spain)

Co-author(s) : Ing Telleria Iosu, Dipl-Ing Aguilar David, Dipl-Ing Dos Santos Rafael, Dr Ing San Sebastian Maria (LORTEK, Spain)

Title : Semi-continuous Functionally Graded Material Austenitic To Super Duplex Stainless Steel Obtained By Laser-based Directed Energy Deposition

Keyword(s) :
Laser Metal Deposition; Directed Energy Deposition; FGM; Super Duplex; Stainless Steel

Abstract :
In this work a functionally graded material between an austenitic and a super duplex stainless steel has been fabricated. These materials are of great interest for the chemical and oil & gas sectors, since the austenitic stainless steel is inexpensive and super duplex stainless steels have better mechanical and corrosion resistance but are more expensive. Using direct laser metal deposition process, it is possible to efficiently combine two or more powders of different chemical composition by automated mixing prior to their delivery it into the nozzle, coaxial to the laser beam for melting. It has been possible to obtain a dense material via additive manufacturing, with minimum defectology and semi-continuous and controlled composition gradient. The resulting microstructure and hardness variations with different composition proportions in the manufacturing direction have been evaluated, starting from stainless steel AISI 316L and with discontinuous increments until achieving 100% of super duplex SAF 2507.

Innovative Aspect(s) :
Obtaining functionally graded materials (FGMs) has been challenging so far, however, with the emergence of metal additive manufacturing processes like directed energy deposition (DED) technologies, it is possible to fabricate complex parts with functional gradients. A major advantage of DED technology is its ability to produce multi-material components, with key importance in solving long-standing problems in dissimilar metal welding and alloys development. Since some laser-based DED processes rely on the use of blown powder as raw material, the ability to mix various powders (in a controlled manner) in situ (i.e., during powder feeding and|or delivery) easily enables the production of complex functional gradients, multi-material layers, and even composites that can include many classes or types of materials. This opens a new horizon for alloys development and innovative industrial applications. In this work, we delve into how the FGM has been obtained and how microstructure and strengthening mechanisms evolves.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235763603

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Mr Bilgin Guney Mert (Tusas Engine Industries Inc. (TEI), Turkey)

Co-author(s) : Ms Gulcan Yesim Nur, Mr Pehlivanogullari Baris, Mr Yilmaz Rifat, Mr Orhangul Akin (Tusas Engine Industries Inc. (TEI), Turkey)

Title : Comparison Of The Mechanical Properties And The Microstructures Of ΓTiAl Fabricated By Electron Beam Melting And Powder Metallurgy Route

Keyword(s) :
Additive Manufacturing; Electron Beam Melting; Powder Metallurgy; Ti48Al2Cr2Nb Alloy; Microstructure; Mechanical Properties; Heat Treatment; Hot Isostatic Pressing

Abstract :
Titanium aluminide based alloys stand out especially for aerospace applications due to their low density, high temperature strength and corrosion resistance. However, due to high reactivity and low ductility at room temperature, various problems are encountered in conventional manufacturing methods. Therefore, great interest has been shown in its near net shaping fabrication by electron beam melting (EBM) additive manufacturing and powder metallurgy (P|M) technologies. In this study, samples were produced from pre-alloyed Ti48Al2Cr2Nb powder using both EBM and P|M methods. As-built EBM Ti48Al2Cr2Nb mechanical properties significantly differ from those of the parts produced by P|M depending on manufacturing direction due to several issues including microstructural instabilities, porosity and residual stresses. The present study was conducted to characterize the microstructure, high temperature tensile strength behavior of EBM and P|M fabricated Ti-48Al-2Cr-2Nb samples in the as-built, HIP'ed and heat-treated conditions within the purpose of utilizing this alloy for structural aerospace applications.

Innovative Aspect(s) :
The existing studies in the literature mainly focused on a single mechanical property of the material by applying heat treatment at a certain temperature to the Ti48Al2Cr2Nb alloy produced by EBM. However, in this proposed study, the final properties were compared with each other to the samples fabricated by EBM and P|M. A serious knowledge has been created for structural aerospace applications by evaluating the microstructural examinations, phase analyzes and high temperature tensile tests for the both EBM and P|M production. For all these reasons, it is thought that the proposed study differs from the existing studies and will contribute to the literature.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2 23
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235763947

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Ing Rodriguez Sanchez Marcos (IMDEA Materials, Spain)

Co-author(s) : Ing Sadanand Saumya, Dr Perez Prado Maria Teresa (IMDEA Materials, Spain), Ing Ghavimi Amirhossein, Dr Busch Ralph, Dr Gallino Isabella (Saarland University, Germany), Dr Tilberto Paola Maria, Dr Ferrera Enzo, Dr Barrera Gabriele (INRIM Istituto Nazionale

Title : Laser Powder Bed Fusion Of Soft Magnetic Bulk Metallic Glasses For Energy Saving Applications

Keyword(s) :
Laser Powder Bed Fusion; LPBF; SLM; Bulk Metallic Glasses; BMG; Soft Magnetic Materials; AM2SoftMag

Abstract :
Fe-based soft magnetic Bulk Metallic Glasses (BMG's) have shown unprecedented coercivity and magnetization saturation values and present the possibility of creating more efficient electromagnetic components, if successfully built. Laser Powder Bed Fusion (LBPF) allows to manufacture relatively large BMG parts while retaining an amorphous microstructure due to high local cooling rates. However, in practice, the thermal cycles generated in the LBPF layer-wise process tend to cause undesired crystallization.This work aims to find the optimal processability window of a commercial water-atomized Fe-based BMG powder using a Renishaw AM400 system with a pulsed-wave laser for fine microstructure control. A complex parameter optimization process is carried out to achieve dense enough prints while retaining the beneficial amorphpus microstructure. Experimental techniques such as X-Ray Diffraction, Differential Scanning Calorimetry, image analysis, magnetic and micromechanical testing were used to evaluate print quality find the best compromise between amorphous fraction and low number of defects.

Innovative Aspect(s) :
Use of LPBF with soft magnetic amorphpus powder for energy saving applications.Processing parameter optimization and thorough microstructural, mechanical and magnetic characterization to achieve prints with a superior soft magnetic behavior. Full use of a pulsed-wave laser LPBF system to achieve a higher amorphous fraction.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235763995

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Prof Dr Schwanekamp Tobias (Rheinische Fachhochschule Koeln, Germany)

Co-author(s) : Mr Zimmer Leon, Prof Dr Reuber Martin (Rheinische Fachhochschule Koeln, Germany)

Title : Additive Manufacturing Of TiC-Ni Cermets By Laser-based Powder Bed Fusion

Keyword(s) :
Additive Manufacturing; PBF-LB; Laser-Based Powder Bed Fusion; Cermet; TiC-Ni; Cutting Tool

Abstract :
Laser-based powder bed fusion (PBF-LB) offers significant potentialities for the design of innovative cutting tools with complex inner and outer shape. Therefore, a lot of research on PBF-LB of tungsten carbide-cobalt (WC-Co) hard metals has been published in recent years. However, a material quality similar to conventionally sintered WC-Co is still not achieved and high cobalt content is required to counteract the intrinsic issues in PBF-LB of WC-Co, resulting in hardness values significantly below those of typical carbide grades for machining. TiC-Ni based cermets could be an interesting alternative, since TiC has a higher hardness than WC. The melting point is also higher, resulting in higher thermal stability during laser exposure. Furthermore, TiC is more robust to variations in stoichiometry than WC. However, PBF-LB of TiC-based cermets is only sparsely investigated. Therefore, the current study focuses on fundamental investigations on processing of TiC-Ni by PBF-LB.

Innovative Aspect(s) :
Additive manufacturing of cutting tools is an innovative field of research and of great industrial interest. In particular, the qualification of new materials for AM of cutting tools is important to expand the range of applications.The most innovative aspect of this study is that today there is only very sparse information of AM of cermets in general. In particular, the authors are not aware of any specific literature on PBF-LB of TiC-Ni, which makes this topic quite new and also of scientific interest.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235764059

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Dr Ing Cordova Laura (Chalmers University of Technology, Sweden)

Co-author(s) : Dr Ing Raza Ahmad, Prof Dr Hryha Eduard (Chalmers University of Technology, Sweden)

Title : Analysis Of Processability And Reusability Of Ti6Al4V Powders For PBF-EB

Keyword(s) :
Powder Bed Fusion Electron Beam (PBF-EB); Powder Reuse; Processability; Ti64; Rheology; XPS

Abstract :
Processability in Powder Bed Fusion Electron Beam (PBF-EB) depends on the interaction of the electron beam with the metal powder. For a good, consolidated part to be processed, the powder must be smoothly applied on the powder bed and the beam transmits the electrons throughout the powder layers. Only with powder of specific characteristics, this is possible (narrow PSD, smooth and spherical morphology, high chemical purity). In this study two different TI6Al4V powder batches are analyzed, one batch presented challenges with processability even in virgin state. For both powders, an assessment of the morphology, particle size, rheology, and chemistry will determine the feasibility to achieve optimal processability and the possibility to reuse in consecutive cycles.

Innovative Aspect(s) :
This study covers the most critical aspect of PBF-EB, processability. When the process starts several challenges can take place as charging -producing the so-called smoke-, recoating issues, etc. When reusing the metal powder for PBF-EB a layer of complexity is added which is the pristine, spherical, high-purity powder is oxidized making it more difficult the processability. In this study two batches of Ti64, a critical material for EBM, is studied. One of the batches had serious issues with processability, making the process cost efficiency low due to it could not be reused more than one time. This work analyzes the root cause of this issue from different perspectives. Characterization of rheology, chemistry, morphology, and particle size gives a complete picture of the potential of these powder batches.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235764236

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Dr Kaserer Lukas (University of Innsbruck, Austria)

Co-author(s) : Dr Braun Jakob, Mr Brennsteiner Daniel, Prof Leichtfried Gerhard (University of Innsbruck, Austria), Dr Leitz Karl-Heinz, Dr Kestler Heinrich, Dr Schafbauer Wolfgang (Plansee SE, Austria)

Title : Comparison Of Different Alloying Concepts For Mo And W For Improving Component Strength And Quality In LPBF

Keyword(s) :
Laser Powder Bed Fusion; Molybdenum; Tungsten; Alloying Strategies

Abstract :
The production of Mo and W components using the additive manufacturing process Laser Powder Bed Fusion (LPBF) makes it possible to produce Mo and W components with highly complex geometries in a resource-efficient way. Such complex components enable optimal functionalization and are of considerable industrial interest.The disadvantage of LPBF is that it is currently impossible to produce pure Mo and W components that achieve a similar strength and quality compared to their traditionally powder-metallurgically produced counterparts. Pure Mo and W components suffer from a coarse-grained, columnar, and cracked microstructure. Material adaptation to tolerate the unique solidification-boundary conditions in LPBF is necessary to improve component quality.In the present work, different alloying concepts to trigger grain refinement, to engineer grain boundary chemistry, and a combination of both are discussed for both Mo ans W. Furthermore, the effects on the microstructure and component quality are compared based on experimental results.

Innovative Aspect(s) :
Presentation of different alloying concepts to counteract the main defect-initiating mechanisms in LPBF of Mo and W.
Experimental results showing the effect on the microstructure.
Experimental results showing the effect on the mechanical properties at room temperature and at elevated temperatures.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235764401

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Dr Batalha Rodolfo (ISQ - Instituto de Soldadura e Qualidade, Portugal)

Co-author(s) : Mr Feliciano Francisco, Dr Morais Paulo (ISQ - Instituto de Soldadura e Qualidade, Portugal), Prof Dr Cruz Maria, Prof Dr Evans Guiomar (University of Lisbon, Portugal)

Title : Development And Characterization Of Fe-Based Soft Magnetic Material Produced By PBF-LB

Keyword(s) :
Additive Manufacturing; Soft Magnetic Materials; Microstructure; Magnetic Properties

Abstract :
Magnetic materials are becoming increasingly important due to the development of renewable energy sources. Soft magnetic components are used in electric machines such as motors, generators, inverters, converters, transformers, and sensors. In this work, we processed Fe-Si-based soft magnetic materials with powder bed fusion-laser beam (PBF-LB), additive manufacturing (AM) technology. The work considered the development of Fe-Si alloys by powder mixture, additive manufacturing of samples, post-processing heat treatments, and the measurement of magnetic properties. The results showed that the thermal history associated with the processing route leads to a notable change in the magnetic properties of the Fe-Si alloys. It is also seen that the microstructure and therefore magnetic properties of the Fe-Si alloy may be tailored by changing the laser scanning strategy in the PBF-LB process.

Innovative Aspect(s) :
The present work is aimed at pushing the current boundaries to a more efficient manufacturing route for producing high-performance Fe-based soft magnetic materials. The impacts are related to the availability and processability of new material compositions for the production of highly efficient electric machines.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235764654

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Dr Ing Baffie Thierry (CEA-LITEN, Univ.Grenoble Alpes, France)

Co-author(s) : Dr Ing Peyrouzet Florian, Dr Ing Navone Christelle, Dr Ing Maisonneuve Julie (CEA-LITEN, Université Grenoble Alpes, France), Dr Ing Gorsse Stéphane (Université Bordeaux, CNRS, Bordeaux INP, ICMCB, UMR 5026, France)

Title : Microstructure And Mechanical Properties Of As-built And Heat-treated Laser Powder Bed Fusion Al0.3CoCrFeNi High Entropy Alloy

Keyword(s) :
Additive Manufacturing; Laser-Powder Bed Fusion; High Entropy Alloy; Microstructure; Heat treatment; Tensile Properties

Abstract :
High entropy alloys (HEAs) are metallic materials composed of a concentrated mixture of multiple principal elements. The Al0.3CoCrFeNi alloy, produced by arc melting and subsequent thermomechanical treatments, is one of the most studied HEAs due to the wide range of microstructures accessible and the associated high mechanical performances. Thanks to Laser Powder Bed Fusion technology (L-PBF) and the high as-built dislocation density obtained, the room-temperature yield strength of this alloy is largely improved compared to as-cast or wrought counterparts while maintaining significant ductility [1].This paper highlights the effect of the control of L-PBF process parameters and of heat treatments on the alloy microstructural components (texture, dislocation density, secondary phases) and tensile properties. Analyses were carried out by X-ray Diffraction (XRD), Scanning Electron Microscopy (SEM), Transmission Electron Microscopy (TEM) and Atom Probe Tomography (APT). [1] F.Peyrouzet et al., JOM, 71 (10) (2019) 3443-3451

Innovative Aspect(s) :
The hierarchical microstructure is characterized by elongated columnar grains along the building direction (BD), sub-grains, solidification cells, a high dislocation density and a small amount of nano-particles. Two preferential crystallographic orientations <100> and <110> are observed. APT analyses in the as-built FCC supersaturated solid solution revealed a chemical short range ordering via the formation of nanometric NiAl-rich clusters.By increasing the L-PBF Volumetric Energy Density, the melt pool morphology can be controlled, thus the <110> fibre texture along the BD can be favoured.A thermal treatment at 620°C leads to the formation of L12 nano-precipitates. At higher temperature, a needle-shaped B2 phase precipitates. These phases contribute to the alloy hardening. The achieved tensile properties surpass those obtained with the same alloy produced by other processes. The range of tensile properties are the following: YS ≈ 625-780 MPa, UTS ≈ 725-1100 MPa and Elongation ≈ 22-46%.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235764661

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Mr Deckers Tobias (Linde GmbH, Germany)

Co-author(s) : Dr Dubiez-Le Goff Sophie, Mr Forêt Pierre (Linde GmbH, Germany), Prof Dr Witt Gerd (University Duisburg-Essen, Germany)

Title : Effects Of A Helium Containing Process Gas Mixture On Laser-Based Powder Bed Fusion Of Metals: A Comparative Study On A Large-Scale Prototype

Keyword(s) :
Additive Manufacturing; Laser Powder Bed Fusion; Process Gas; Argon; Helium; Oxygen Content; Alloy 718; Sustainability

Abstract :
Previous research could prove that argon-helium mixtures are beneficial to mitigate the formation of process-by products deleterious for the quality and the reproducibility of laser-based powder bed fusion of metals (PFB-LB|M). This study was conducted on Alloy 718 to transfer previous research results to a part reaching machine volume capabilities. During printing, the process was analyzed through different process monitoring and quality assurance tools such as EOSTATE Exposure OT, EOSTATE MeltPool Monitoring and time-lapse photography. Those tools and the direct visual observation revealed next to less defects, less process by-products also less discolored spatter while using an argon-helium mixture. Consequently, due to the reduction of by-products generated, a significant reduction of machine filter clogging was observed.The part dimension allowed the quantification of the process sustainability: A reduction in powder loss, less defective parts, and increased longer powder reusability was detected.

Innovative Aspect(s) :
Process Sustainability; Decrease Powder Loss; Decrease Maintenance|Service Intervalls; Improve Surface & Part Quality; Extend Filter Life; Extend Powder Use

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023 CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235764682

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Mr Rosito Michele (Politecnico di Torino, Italy)

Co-author(s) : Mr Vanzetti Matteo, Dr Padovano Elisa, Prof Bondioli Federica, Prof Badini Claudio (Politecnico di Torino, Italy), Ing Gili Flavia, Ing Dellacà Valentina, Ing Tedesco Michele Maria (Stellantis, Italy)

Title : Investigation On LPBF Processability Of An In-situ A6061 Matrix Composite

Keyword(s) :
LPBF; A6061; MMC; Metal Matrix Composite; Grain Refiners; High Strength Aluminium Alloys

Abstract :
The interest in laser powder bed fusion (LPBF) has grown in the last decades because of the possibility to obtain near-net shapes parts with high performance. However, the main issue in this process is the limited availability of materials. For instance, A6061 alloy has a wide application range but it is hardly processable for LPBF because of a severe solidification cracking. This critical issue can be overcome through the introduction of nucleants in the system, which induce an equiaxed solidification and avoid the solidification cracks. A6061 RAM2 is a mixture of A6061, Ti and B4C particles capable to react with each other to synthetise TiC and TiB2, grain refiners for Al alloys. A parameters optimization to produce dense samples was performed. Microstructural characterization of these specimens was carried out to investigate the evolution of the system in the processed material. Then, preliminary evaluation of mechanical properties was performed.

Innovative Aspect(s) :
High-strength aluminium alloys have a wide range of applications but their processability for laser powder bed fusion (LPBF) is very challenging. Indeed, these alloys have a wide solidification range and show a columnar-dendritic grain growth, which lead to a severe solidification cracking and a dramatic fall of mechanical properties. Currently, different approaches to improve the processability of these alloys for LPBF are verified: the increasing of Si content of the alloy, the preheating of the platform, and the use of grain refiners, usually with nanometric size. The innovative approach of this study consists of the combination of the synthesis of an in-situ metal matrix composite and the introduction of grain refiners in the system. The in-situ production of the reinforcement provides auxiliar heat, due to the exothermic reaction, and inoculant phases with a strong interfacial bond, leading to an equiaxed solidification and avoiding solidification cracking.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235764712

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Dr Tobar Maria Jose (Universidade Da Coruña, Spain)

Co-author(s) : Dr Amado Jose Manuel, Dr Camba Carolina, Dr García Ana Isabel, Dr Mier Jose luis, Dr Luaces Alan, Dr Yañez Armando (Universidade Da Coruña, Spain)

Title : Characterization Of Compositionaly Graded A316L|Inconel 625 Profiles Manufactured By Laser Direct Energy Deposition Using Different Precursor Powders

Keyword(s) :
AM; Laser DED; Inconel 625; 316L; Functionally Graded Material; Multimaterial

Abstract :
Multimaterial additive manufacturing allows to obtain near-net-shape components with local customized properties. Combining different alloys, significant increased life service, functionality and cost savings are to be expected if mechanical, thermal, electric|magnetic properties can be tailored to specific demands. The laser DED technology provides with a natural environment for multi-material manufacturing with steels and high performance alloys. They can be mixed along the process with custom mixing ratios, although this is usually performed by developing compositionally graded interfaces between different materials. As when processing single alloys, laser DED deposits often suffer from known detrimental features as porosity, micro-segregation, cracks and|or directional grain growth. In this work this features will be examined in compositional graded A316L|Inconel 625 laser DED samples manufactured with powders from different providers. It will be analysed whether the morphology or minor elemental composition of the powders might influence the microstructure and mechanical characteristics of the deposited material.

Innovative Aspect(s) :
The feasibility of multi-material additive manufacturing with metal o metal-ceramic alloys provides a unique opportunity for material selection of customized characteristics. Any successful initiative in this respect, combining different material properties, is expected to expand the development of metal structures that cannot be achieved with traditional manufacturing techniques. The success of the multi-material structure, especially in hard service conditions applications, depends on the strength and integrity of the metallurgical interface between materials. Ultimately, the performance of additive manufactured parts is known to depend in many factors, including the characteristics of the raw feedstock material. This aspect should be further studied in order to advance on the standarization of the process. In this work we aim to provide with experimental evidence in the specific case of multimaterial 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 PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235765041

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Prof Azadbeh Maziyar (Sahand University of Technology, Iran)

Co-author(s) : Ms Eslami Samira, Ms Golchinfard Mahsa, Ms Gaffari Faezeh (Sahand University of Technology, Iran), Prof Danninger Herbert, Prof Gierl Mayer Christian (Vienna University of Technology, Austria)

Title : Comparing Microstructure And Properties Of Ti And Ti-10Mo Alloys Prepared By Selective Laser Melting

Keyword(s) :
Ti-10Mo; Selective Laser Melting; Beta Phase; Molten Pool

Abstract :
This study focuses on the influence of adding Molybdenum to Ti on properties, microstructure and presumably formation of beta phase. For this purpose, specimens from plain Ti powder and Ti-10Mo mixed elemental powders, respectively, were fabricated by selective laser melting (SLM) under the same parameters in argon atmosphere. The laser power, scanning speed and hatch distance were 95 W, 600 mm.s-1 and 0.088 mm, respectively. Ti-10Mo alloy was prepared successfully by SLM of elemental powder mix, a few undissolved Mo particles remaining, the distribution of which in the Ti matrix was fairly uniform. The molten pools are clearly visible in the micrographs of Ti-10Mo, but surprisingly not in Ti. The UTS of Ti was 624 MPa, and Mo addition caused an increase to approx. 940 MPa and of the hardness to 467 HV30, whereas the elongation of Ti was considerably higher than of Ti-10Mo.

Innovative Aspect(s) :
Ti-10Mo alloy was prepared successfully by SLM of elemental powder mix; a few residues of Mo particles are still contained. In the micrographs of Ti-10Mo the molten pools are clearly visible, while surprisingly not in Ti, although the manufacturing parameters for both were the same. The UTS of Ti was 624 MPa, and Mo addition caused an increase to approx. 940 MPa, indicating effective Mo distribution, whereas the elongation of Ti was considerably higher than Ti-10Mo. Relatively higher elongation of Ti may be related to the lamellar structure produced in 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 PM2023 CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235765159

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Dr Batalha Rodolfo (ISQ - Instituto de Soldadura e Qualidade, Portugal)

Co-author(s) : Mr Carvalho André, Prof Dr Evans Guiomar (University of Lisbon, Portugal), Dr Morais Paulo, Dr Cabral Ana (ISQ - Instituto de Soldadura e Qualidade, Portugal)

Title : Laser-Powder Bed Fusion Of Ti-Based Alloys For Biomedical Applications

Keyword(s) :
Laser-Powder Bed Fusion; Additive Manufacturing; Ti Alloys; Biocompatible

Abstract :
The focus of this work is to process new biocompatible Ti alloys solely constituted of non-toxic elements by laser-powder bed fusion (L-PBF), a metal additive manufacturing (AM) technology. The main L-PBF processing parameters such as laser power and scanning speed were defined to obtain highly dense samples. The effects of the addition of a second particle and the influence of the scanning strategy on the microstructure of the Ti-based alloys were investigated, showing the possibility for in-situtailoring the material properties in the L-PBF process. Finally, some prototypes were manufactured proving the feasibility of manufacturing parts of Ti-based biocompatible alloys with complex geometry by L-PBF.

Innovative Aspect(s) :
The impacts of the present work are related to the availability of new biocompatible Ti alloys produced by additive manufacturing. The envisioned benefits are a microstructure designed for enhanced functional performance, improved biomechanical compatibility, and the realization of implant designs with increased functionality.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235765271

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Miss Lerda Serena (Politecnico di Torino, Italy)

Co-author(s) : Dr Marchese Giulio, Dr Bassini Emilio, Prof Lombardi Mariangela, Prof Ugues Daniele, Prof Fino Paolo, Prof Biamino Sara (Politecnico di Torino, Italy)

Title : Microstructure And Heat Treatment Investigation Of Inconel 625|TiC Composite Produced By Laser Powder Bed Fusion

Keyword(s) :
Inconel 625; Laser Powder Bed Fusion; Recrystallization; Microstructure; Ni-Based Superalloy; Composites

Abstract :
Inconel 625 (IN625) is a Ni-based superalloy characterized by good mechanical performance and excellent oxidation resistance up to 1000°C. In order to enhance the mechanical performances of the IN625, ceramic particles can be added to the alloy. In the current work, the IN625 powder was mixed with submicrometric TiC particles and then processed by the laser powder bed fusion (LPBF) process. The microstructure of the as-built and heat-treated composite was compared to the base alloy in order to investigate the variations in terms of microstructure. The as-built condition of the IN625 and composite exhibited columnar grains with very fine dendritic structure along the building direction. Differently, a high-temperature solution annealing involved recrystallization of the IN625 samples while the composite still presented columnar grains, thus showing higher microstructure stability at elevated temperatures.

Innovative Aspect(s) :
The production of Ni-based composites by laser powder bed fusion (LPBF) can be an effective way to fabricate materials with high mechanical performance. In this work, Inconel 625 alloy was reinforced by TiC particles to improve mechanical properties and microstructure stability under heat treatments. This work investigates the beneficial effect of the reinforcement of TiC particles inside the Inconel 625 alloy. For this purpose, the microstructure of both IN625|TiC composite and Inconel 625 was characterized and compared in the as-built and heat-treated conditions.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235765364

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Dipl-Ing Khademzadeh Saeed (Chalmers University of Technology, Sweden)

Co-author(s) : Ing Pigato Mirko (University of Padova, Italy), Prof Nyborg Lars (Chalmers University of Technology, Sweden)

Title : Laser Powder Bed Fusion Of H13 Tool Steel|CuSn10 Bimetallic Structures: Improvement Of Interfacial Bonding And Mechanical Strength

Keyword(s) :
Multimaterials; Laser Powder Bed Fusion; Mechanical Strength; Tool Steel

Abstract :
H13 hot work tool steel and CuSn10 multi-material structures were fabricated via laser powder bed fusion. Aiming at higher bonding strength, a transition layer was considered either through employing modified process parameters for interfacial layers or by using a transition material e.g., Ni-based alloy. Interfacial characteristics were analyzed using X-ray diffraction, scanning electron microscopy, energy dispersive spectroscopy and electron back-scattered diffraction techniques. Relationships among process parameters (laser power, scanning speed, and scanning strategy) and mechanical performance were elucidated. The bonding strength of bimetallic structures was evaluated through uniaxial tensile tests. The highest strength reached 450 MPa, which is higher than that of the CuSn10 and corresponds to a structure with a defect-free transition layer induced by optimum process parameters as well as smooth hardness change at the interface.

Innovative Aspect(s) :
This works presents innovative approaches in AM of defect-free multimaterials using LPBF.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235765447

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Dr Braun Jakob (University of Innsbruck, Austria)

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

Title : Possibilities For Reducing The Moisture Content In Metallic Powders And Its Effect On The LPBF Process

Keyword(s) :
LPBF; Impurities; Moisture Content; Defect Generation; Powder Cleaning

Abstract :
In this paper, the authors present the influence of moisture in metal powder on the LPBF process for selected alloys, based on the effect on microstructure and mechanical properties. Methods for measuring moisture content in metallic powders are presented and, as the focus of the study, methods for reducing moisture in the metal powder are presented. The methods of vacuum drying, oven treatment and a specially developed plasma cleaning for metallic powders in the LPBF process are compared. The achievable value of powder drying is put in relation to its applicability in the industrial LPBF process environment and user recommendations are given for the necessity and type of powder drying of as-delivered, stored and recycled LPBF powders.

Innovative Aspect(s) :
- First comparison of different drying methods for reducing moisture in the metal powder for LPBF.- Unveiling a new plasma cleaning method for moisture and other contaminants in metal powders, which offers an improvement in component properties of parts made from stored and recycled powders.- The effects of improper transport conditions on the side of the powder manufacturer and improper storage|handling by the user on the achievable component quality.- Characterization of defects caused by small moisture impurities in the powder that do not affect the flowability of the powder, but still lead to cracks, porosity or inclusions in the respective alloy system.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235765625

Requested presentation type : Oral Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Miss Lupi Giorgia (Politecnico di Milano, Italy)

Co-author(s) : Dr Teixeira Oliveira de Menezes João, Dr Belelli Filippo, Prof Castrodeza Enrique Mariano, Prof Casati Riccardo (Politecnico di Milano, Italy), Mr Bruzzo Francesco (Fraunhofer IWS, Germany), Prof Volpp Joerg (Luleå University of Technology, Sweden)

Title : Fracture Toughness And Fatigue Properties Of AlSi10Mg Alloy Produced By Direct Energy Deposition With Different Crack Plane Orientations

Keyword(s) :
AlSi10Mg Alloy; Direct Energy Deposition; Tensile Properties; Fracture Toughness; Fatigue Properties; Crack Orientation Anisotropy

Abstract :
In this work, fracture, fatigue, and tensile properties of AlSi10Mg alloy processed by Direct Energy Deposition (DED) in atmospheric conditions were assessed. Fracture SE(B) and fatigue ESE(T) specimens were printed and machined having the cracks in three different crack plane orientations for evaluating the performance and influence of crack orientation on mechanical properties. Samples were subjected to different heat treatments routes. Microstructural and fractographic analyses were performed by FE-SEM. It was observed that the mechanical and fracture behavior of the material is strongly affected by the crack plane orientation and porosity distribution. Moreover, fatigue crack growth studies were backed by EBSD analyses, the results shed light on the effect of melt pool boundaries, grain boundaries and crystallographic orientation of grains on the crack path for the different crack plane. orientations.

Innovative Aspect(s) :
The DED of Al alloys is challenging due to their high reflectivity, high thermal conductivity, and high residual stresses. Manufacturing of Al parts characterized by sound microstructure is still rather challenging. To the best of authors knowledge, no studies on fracture toughness and fatigue crack growth of AlSi10Mg alloy produced by DED are available in the open literature. Such data are extremely interesting from an industrial standpoint. A complete set of mechanical tests was coupled with an in-depth study of the microstructural features, leading to a comprehensive understanding of the material behavior.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235764626

Requested presentation type : Poster Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Ms Soares Barreto Erika (Leibniz-Institute for Materials Engineering - IWT, Germany)

Co-author(s) : Ms Soares Barreto Erika, Prof Dr Mädler Lutz, Dr Ing Ellendt Nils (University of Bremen, Germany), Mr Kaja Mohideen Nabeel Ahamed, Prof Dr Mädler Lutz (Leibniz-Institute for Materials Engineering - IWT, Germany)

Title : Increasing The Powder Yield On The Additive Manufacturing Of Cu47Ti34Zr11Ni8 Metallic Glass

Keyword(s) :
Metallic Glasses; Gas-Atomization; Laser-Based Powder Bed Fusion of Metals (PBF-LB|M); Powder Yield

Abstract :
Additively manufactured (AM) Cu-Ti-based metallic glasses represent advantages to developing low-cost alloys that meet performance requirements for industrial applications. With high-strength and reasonable glass-forming ability, they possess economically attractive starting materials and small oxygen sensitivity. It is also of economic interest to increase the usable powder fraction of the AM feedstock. Larger particles are preferred because they uptake less oxygen during the gas-atomization, as they have a lower surface-to-volume ratio. Nonetheless, the drawback is seen in the higher chance of defect formation and reduced cooling rates, which may cause crystallization as thicker layers are required. Here, the processability of commercial purity, argon-atomized Cu47Ti34Zr11Ni8 alloy via laser powder bed fusion (PBF-LB|M) is investigated using a powder feedstock with up to 90 µm particles. Suitable laser parameters and strategies are investigated to enhance vitrification and reduce defect generation. The present contribution enables significant knowledge gains to the processability of economical metallic glasses.

Innovative Aspect(s) :
By increasing the powder fraction used as feedstock for PBF-LB|M, a higher yield is obtained from the gas-atomization process. This is associated with a reduced production cost, better usage of resources (such as the material feedstock, gas, crucible, and others), and energy-saving. The consequences are the better efficiency of the powder metallurgy production chain and the enhanced competitiveness of metallic glasses towards conventional crystalline alloys. In addition, new scanning strategies support also the processability of metallic glasses with a reduced glass-forming ability, which normally faces (partial) crystallization during additive manufacturing.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

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EURO PM2023
CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235765420

Requested presentation type : Poster Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Ms Soares Barreto Erika (Leibniz-Institute for Materials Engineering - IWT, Germany)

Co-author(s) : Ms Soares Barreto Erika, Prof Dr Mädler Lutz, Dr Ing Ellendt Nils, Mr Kaja Mohideen Nabeel Ahamed, Prof Dr Mädler Lutz (Leibniz-Institute for Materials Engineering - IWT, Germany)

Title : Increasing The Powder Yield On The Additive Manufacturing Of Cu47Ti34Zr11Ni8 Metallic Glass

Keyword(s) :
Metallic Glasses; Gas-Atomization; Laser-Based Powder Bed Fusion of Metals (PBF-LB|M); Powder Yield

Abstract :
Additively manufactured (AM) Cu-Ti-based metallic glasses represent advantages to developing low-cost alloys that meet performance requirements for industrial applications. With high-strength and reasonable glass-forming ability, they possess economically attractive starting materials and small oxygen sensitivity. It is also of economic interest to increase the usable powder fraction of the AM feedstock. Larger particles are preferred because they uptake less oxygen during the gas-atomization, as they have a lower surface-to-volume ratio. Nonetheless, the drawback is seen in the higher chance of defect formation and reduced cooling rates, which may cause crystallization as thicker layers are required. Here, the processability of commercial purity, argon-atomized Cu47Ti34Zr11Ni8 alloy via laser powder bed fusion is investigated using a powder feedstock with up to 90 µm particles. Suitable laser parameters and strategies are investigated to enhance vitrification and reduce defect generation. The present contribution enables significant knowledge gains to the processability of economical metallic glasses.

Innovative Aspect(s) :
By increasing the powder fraction used as feedstock for PBF-LB|M, a higher yield is obtained from the gas-atomization process. This is associated with a reduced production cost, better usage of resources (such as the material feedstock, gas, crucible, and others), and energy-saving. The consequences are the better efficiency of the powder metallurgy production chain and the enhanced competitiveness of metallic glasses towards conventional crystalline alloys. In addition, new scanning strategies support also the processability of metallic glasses with a reduced glass-forming ability, which normally faces (partial) crystallization during additive manufacturing.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

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EURO PM2023 CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235765308

Requested presentation type : Poster Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Dr Ing Smolina Irina (Wroclaw University of Science and Technology, Poland)

Co-author(s) : Dr Ing Gruber Konrad, Dipl-Ing Stopyra Wojciech, Dipl-Ing Kasprowicz Marcin, Dr Ing Kobiela Karol (Wroclaw University of Science and Technology, Poland)

Title : Challenges In PBF-LB|M Processing Of Al5052 Aluminium Alloy

Keyword(s) :
Aluminium; PBF-LB|M; Microstructure; Porosity; Additive Manufacturing

Abstract :
The interest in laser beam powder bed fusion (PBF-LB|M) additive manufacturing (AM) of aluminium is constantly growing. Currently, the most popular aluminium' AM-dedicated alloys are based on Al-Si (4xxx series), while other Al-alloy groups are in the minority. One of the least widespread groups of Al alloys is the Al-Mg 5xxx series. Currently, only two modified alloys can be processed by PBF-LB|M. In this work, we present the main technological challenges in PBF-LB|M processing, and the Al5052 alloy of the 5xxx series is used as an example. Discussions include hot and liquation cracking. The analysis process parameters impact porosity, cracks, and microstructure are presented to illustrate the above-mentioned challenges. Potential directions to overcome the challenges are also introduced.

Innovative Aspect(s) :
Challenges In PBF-LB|M Processing Of Al5052 Aluminium Alloy as an example of processing 5xxx series of aluminium alloys.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

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EURO PM2023 CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235765321

Requested presentation type : Poster Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Dr Ing Montealegre-Melendez Isabel (Universidad de Sevilla, Spain)

Co-author(s) : Dr Arevalo Cristina, Dr Ing Perez-Soriano Eva María (Universidad de Sevilla, Spain), Ing Ariza Enrique, Dipl-Ing Kitzmantel Michael, Dr Ing Neubauer Erich (RHP Technology GmbH, Austria)

Title : Manufacturing Of Hastelloy C22 Specimens Via Plasma Metal Deposition To Determinate The Influence Of The Processing Parameters On The Final Properties

Keyword(s) :
Plasma Metal Deposition; Hastelloy C22; Processing Parameters

Abstract :
The starting material was powder manufactured via Plasma Atomization Process; the composition of this powder was the standard Hastelloy C-22. The device employed was a Plasma Metal Deposition one. The argon atmosphere was constant in the manufacturing cycles.In previous studies this material has been processed via PMD varying the granulometry of the powders, however, the parameters remained constant. Therefore, it seeks to provide an answer to the optimal manufacturing parameters depending on the fixed demands.This work aims to investigate the effect of the processing parameters of specimens made from Hastelloy C-22 powder fabricated via Plasma Metal Deposition (PMD), with the objective of deepening the knowledge of this material regarding the composition and microstructure related with the goodness of this additive manufacturing technique.The obtained results confirmed the influence of the parameters on the final properties.

Innovative Aspect(s) :
Regarding the innovative aspects of this work, the development of specimens from Hastelloy C-22 powder via Plasma Metal Deposition offered the possibility of reducing the cost of material and energy. To manufacture components the fewer resources spent, the best sustainability and the rentability of a technique achieved.In the framework of metals, Hastelloy C-22 is a nickel-based austenitic alloy. It presents excellent corrosion resistance, in addition to good mechanical properties. Among its properties, it can include high resistance to pitting and crevice corrosion, in addition to stress corrosion cracking. Therefore this alloy is attractive when long-live durability is demanded. There is a need for studying the relationship between the processing parameters and the final properties of the components produced in order to obtain specimens under the requirements.In summary, this work contributed to increasing the knowledge of PMD and Hastelloy C22.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

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EURO PM2023 CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235765348

Requested presentation type : Poster Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Ms Schwerz Claudia (Chalmers University of Technology, Sweden)

Co-author(s) : Prof Dr Nyborg Lars (Chalmers University of Technology, Sweden)

Title : In-situ Monitoring Targeted To Macroscopic Deviations In Laser Powder Bed Fusion

Keyword(s) :
Process Monitoring; Defects; Distortion; Powder Bed

Abstract :
The application of laser powder bed fusion (LPBF) as a reliable manufacturing technology still faces obstacles, thanks partly to the frequent occurrence of process defects. Delamination and geometric deviations from the nominal model are examples of issues that may occur in the process. In-situ monitoring can potentially be employed to identify diverse anomalies during manufacturing. In this work, the use of optical tomography and powder bed monitoring for the identification of macroscopic deviations is assessed. The manufactured parts were affected by factors such as irregularities in the powder spreading and inadequate supporting, which induced distortions, surface deviations and large voids. The monitoring systems are used to flag different errors by identification of trouble spots that culminated in deviations that severely compromised the integrity of the parts. Three-dimensional reconstruction of the parts based on the layerwise output of the monitoring system and comparison to the nominal model is also performed.

Innovative Aspect(s) :
There is a consensus that in-situ monitoring has great potential to identify anomalies in laser powder bed fusion. Many are the sources of anomalies in the process, but the most relevant ones are those that lead to part scraping. We show how some macroscopic anomalies that severely compromise the integrity of the parts can be flagged by in-situ monitoring.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

Withdraw ☐ Reason : .....

Notes to author : .....

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EURO PM2023 CONGRESS & EXHIBITION
01-04 October 2023

Paper Number : EP235765663

Requested presentation type : Poster Presentation

Topic : Consolidation Technologies **Subtopic :** AM Beam Based Technologies

Author : Miss Maia Mariana (FEUP, Portugal)

Co-author(s) : Miss Fernandes Adriana, Miss Oliveira Elsa (FEUP, Portugal), Mr Costa José, Dr Sequeiros Elsa (LAETA|INEGI, Portugal)

Title : Dimensional, Surface, Microstructural, And Mechanical Characterization Of A Topologically Optimized Aluminum Bicycle Pedal Crank Produced By Laser Powder Bed Fusion

Keyword(s) :
Bike Crank; AlSi10Mg; LPBF; DfAM; Topology Optimization

Abstract :
AM technologies have unlocked new methods of creating new products, allowing a wide range of geometric shapes that are impossible or highly costly through conventional ways. This work explores the topology optimization and characterization of a bicycle pedal crank in AlSi10Mg produced by LPBF. The design for AM was developed using Fusion 360 and nTopology. It reduced 20% of the initial mass, and the component was validated according to ISO 14781. AlSi10Mg powders were evaluated. The part was produced, and surface roughness and dimensions, microstructure, and Vickers hardness were assessed in the final part. The dimensional analysis showed a mean deviation of 7%. The final part presents a hardness of 134±3 HV0.3. The component accomplishes all main requirements expected for product applications; however, finishing procedures are needed due to high roughness. AM proved to be an alternative process for manufacturing a lightweight component, thus similar performance to conventional.

Innovative Aspect(s) :
This study mostly demonstrates the strengths of using AM technologies, especially LPBF, in producing add-value components. It explores the procedure for a new add-value component based on a "conventional" component. It includes not only the topology optimization but also the manufacturing and characterization of the component. It is a complete study from the design to the final part, including material characterization.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

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