EURO PM2024 CONGRESS & EXHIBITION

Technical Programme Committee

8th of February 2024

ABSTRACTS BOOK

POWDERS

EPMA
european powder metallurgy association

EURO PM2024 CONGRESS & EXHIBITION

Technical Programme Committee
8th of February 2024

POWDERS

POWDER CHARACTERISATION AND PROPERTIES

EPMA
european powder metallurgy association

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

Paper Number : P01
ID : 6283045

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Characterisation & Properties

Author : Dr Neveu Aurélien (GranuTools, Belgium)

Co-author(s) :

Title : Predicting Powder Spreadability To Improve Layer Quality In Powder Bed Processes

Keyword(s) :
Powder Bed Fusion, Spreadability, Powder Rheology, Cohesive Index

Abstract :
A good powder spreadability is essential in powder bed-based processes to ensure the production of smooth and homogeneous layers during recoating. However, the evaluation of the spreadability inside the printer requires a sufficiently large batch to fill the machine and is a very time-consuming process, especially the cleaning of the machine. Therefore, having a simple way to predict the spreadability beforehand should drastically reduce the cost at the powder selection stage. In this study, we show that a good correlation is found between the Cohesive Index metric evaluated in a rotating drum and the quality of the layer deposited in a SLM printer (SLM280, SLM Solutions). A wide range of metal powders of different materials and particle sizes have been characterized in the rotating drum. In addition, layers have been produced in the printer and analyzed with an image processing algorithm to obtain a measure of the spreadability.

Innovative Aspect(s) :
In this paper, we use a state of the art characterization method to evaluate the powder cohesiveness in a dynamic regime, close to the one seen by the material during recoating operations. We show that the results can be correlated with the spreadability evaluated in the printer. This should provide a cost effective method to select the best material properties beforehand to optimise the layers quality.

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 : P02
ID : 6283052

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Characterisation & Properties

Author : Dr Aydinyan Sofiya (Tallinn University Of Technology, Estonia)

Co-author(s) : Ms Melkonyan Syuzanna (A.B. Nalbandyan Institute of Chemical Physics, Armenia); Dr Zakaryan Marieta (A.B. Nalbandyan Institute of Chemical Physics, Armenia); Dr Kirakosyan Hasmik (A.B. Nalbandyan Institute of Chemical Physics, Armenia)

Title : Combustion Synthesis Of Nacre-like Architectured High Entropy Ceramics

Keyword(s) :
Nacre-Like Architecture, High Entropy Materials, Combustion Synthesis

Abstract :
Renewable energies are a competitive and promising alternative to fossil fuels, as they have remarkable potential to convert various sources of energy into electricity without greenhouse emissions. The next generation materials for renewable energy should comprise high fracture toughness without sacrificing hardness, and straightway absorbance of sunlight, exhibit enhanced magnetic susceptibility, provide higher efficiencies and cost reduction. The quest for coveted materials has spawned the idea of novel high entropy ceramics that ideally combine superior features of metals and ceramics. As an added value, a bioinspired architecture that mimics mother-of-pearl in these materials will contribute to their unusually high fracture strength and reduce reflectivity over a wide range for solar energy harvesting. We have produced high purity ceramics at affordable costs from available precursors, with a long shelf life by means of an environmentally friendly self-propagating high-temperature synthesis (SHS) with very low power consumption, and easy to scale (kg|min).

Innovative Aspect(s) :
Nacre-like hierarchic microstructure was bioreplicated in high-entropy ceramics for the first time by means of combustion synthesis.

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 : P03
ID : 6282776

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Characterisation & Properties

Author : Ing Sandoval Neyder A. (Universidad Carlos III de Madrid, Spain)

Co-author(s) : Ing S. Villanueva Alejandro (Universidad Rey Juan Carlos, Spain); Dr Ramos Joaquin R. (Universidad Rey Juan Carlos, Spain); Dr Torres Belen (Universidad Rey Juan Carlos, Spain); Dr R. Herrero Pilar (Universidad Rey Juan Carlos, Spain); Dr Cifuentes Sandra C. (Universidad Rey Juan Carlos, Spain); Dr Tsipas Sophia A. (Universidad Carlos III de Madrid, Spain)

Title : Influence Of Surface Modification Of Powders By Fluidized Bed On The Microstructure And Properties Of Parts Produced By Selective Laser Melting

Keyword(s) :
SLM, Powders Modified, Fluidised Bed, Scalable Process

Abstract :
The improvement of beam-based additive manufacturing processes, such as selective Laser Melting (SLM) is currently generating industrial and scientific momentum because of the great advantages it offers in terms of design, flexibility, and efficiency. Although SLM is widely studied, it has certain disadvantages in part due to the limited availability of raw metal or metal-ceramic powders used, prone to processing issues like microstructural defect and low reproducibility. To partly address these challenges, in this work, powders were surface modified using a fluidised bed to improve the characteristics and processability and adapt them to the SLM using a scalable process. The modified powders were characterized by different techniques and the influence of the surface modification on their processability was analysed. In addition, the effect of printing parameters was investigated. Finally, the microstructure, density and certain mechanical properties of parts obtained by SLM using the modified powders were studied.

Innovative Aspect(s) :
Application of an innovative fluidized bed surface modification to raw metal or metal-ceramic powders for SLM, aiming to improve material characteristics and processability; A scalable approach, ensuring the application to an industrial level for practical implementation of surface modification of powders for direct beam-based additive manufacturing processes.

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 : P04
ID : 6221756

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Characterisation and Properties

Author : Ing Nava Harry (Amelt Corporation, Canada)

Co-author(s) :

Title : An Analysis Of Ramming Refractory ,sintering Method Safety And More Melting Batches In A Medium Frequency Induction Melting And Holding Furnace

Keyword(s) :

Abstract :
This study focuses on enhancing medium frequency induction melting and holding furnaces by optimizing the dry refractory ramming procedure, ensuring sintering method safety, and addressing mechanical and thermal shocks. The dry refractory ramming process's critical role in improving furnace durability and thermal stability is explored, emphasizing material selection for effective resistance to extreme conditions. Safety considerations for sintering methods are detailed, emphasizing the need for stringent protocols to protect personnel and equipment during this phase. The study also addresses the challenge of both mechanical and thermal shocks during sintering, proposing holistic strategies for minimizing their impact. These insights provide practical guidance for metallurgists and operators seeking to maximize the efficiency, safety, and reliability of industrial melting processes.

Innovative Aspect(s) :
This study unfolds innovative dimensions in the optimization of medium frequency induction furnaces. A key innovation lies in the meticulous refinement of the dry refractory ramming procedure, where a strategic selection and application of materials are employed to augment furnace durability and ensure thermal stability under extreme conditions. Notably, the infusion of advanced safety considerations into sintering methods marks a pioneering step, emphasizing the establishment of stringent protocols to safeguard both personnel and equipment during this critical phase. The study further breaks new ground by addressing the multifaceted challenge of minimizing both mechanical and thermal shocks during the sintering process. This innovation involves proposing holistic strategies for shock management, introducing a comprehensive approach to enhance the overall resilience of the furnace system. These groundbreaking insights collectively redefine the landscape for metallurgists and furnace operators, providing a novel framework that promises heightened efficiency, advanced safety, and unparalleled reliability in the realmMeltingprocess.

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 : P05
ID : 6246174

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Characterisation and Properties

Author : Mr Norda Michael (Fraunhofer-Institut für Fertigungstechnik und Angewandte Materialforschung (IFAM), Germany)

Co-author(s) : Mr Lübbe Jan (Fraunhofer-Institut für Fertigungstechnik und Angewandte Materialforschung (IFAM), Germany); Ms Reineke Lea (Fraunhofer-Institut für Fertigungstechnik und Angewandte Materialforschung (IFAM), Germany); Dr Hein Sebastian Boris (Fraunhofer-Institut für Fertigungstechnik und Angewandte Materialforschung (IFAM), Germany)

Title : Development Of A Method For Quality Control And Reprocessing Of Metal Powders In Metal Binder Jetting

Keyword(s) :
Metal Binder Jetting, Powder Quality

Abstract :
The metal binder jetting (MBJ) process is a powder bed-based Additive Manufacturing (AM) process, which is attracting growing interest. In this process, a liquid binder deposited by a print head bonds the powder particles to create green parts. For a reliable metal binder jetting process, the metal powder must have high quality. The morphology and particle size distribution have a major influence on the flowability and sinterability of the material. In this work, the aging process is observed particularly with regard to the slightly disappearing fine fraction during the process. A practical method is presented to reliably detect the ageing process of the powder. In addition, a method is developed to stop or curb ageing to support constant printing conditions. The experiments are conducted using 17-4PH stainless steel. Several properties of powders and parts are analysed such as particle size distribution, green part density, powder bed density and dimensional tolerances.

Innovative Aspect(s) :
The key innovation lies in addressing the aging process of metal powders used in MBJ, particularly the gradual disappearance of fine fractions during printing. The study introduces a practical method to reliably detect this aging phenomenon, crucial for maintaining consistent printing conditions. Additionally, a novel method is developed to either halt or mitigate the aging process, ensuring ongoing stability in the printing environment. By enhancing the understanding and control of powder aging in MBJ, this research contributes to improving the quality and reliability of the metal binder jetting process, facilitating advancements in additive manufacturing technology.

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 : P06
ID : 6268362

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Characterisation and Properties

Author : Dr Weinmann Markus (Taniobis GmbH, Germany)

Co-author(s) : Dr Stenzel Melanie (Taniobis GmbH, Germany); Mr Johannsen Jan (Fraunhofer IAPT, Germany); Dr Lauhoff Christian (University of Kassel, Institute of Materials Engineering, Germany); Prof Dr Niendorf Thomas (University of Kassel, Institute of Materials Engineering, Germany)

Title : Development, Structural Characterization, And Laser Beam Powder Bed Fusion Of Ti|Nb|Ta Alloy Powders

Keyword(s) :
Electrode Induction-Melting Gas Atomization (EIGA), Titanium|Niobium|Tantalum, Pre-Alloyed Refractory Metal Powder, Laser-Beam Powder Bed Fusion, Biomedical Alloy

Abstract :
The development of spherical Ti|Nb|Ta alloy powders in a wide composition range by electrode induction-melting gas atomization (EIGA) and their processing by laser beam powder bed fusion are reported. Microstructure investigations by X-ray diffraction, scanning electron microscopy including energy dispersive X-ray spectroscopy and electron backscatter diffraction reveal a significant impact of the composition on the structural properties, i.e., phase evolution of the materials, and the possibility for a direct microstructure design. Ti-rich alloys preferably solidify in the orthorhombic a''-phase, whereas in Nb|Ta-rich alloys the body-centered cubic ß-phase is observed. The alloys possess a very broad processing window and can be printed to full density over a wide range of printing parameters. Additively manufactured Ti-27Nb-6Ta shows a unique behavior, since strength and elongation at failure strongly depend on the printing parameters applied. The underlying microstructural mechanisms, i.e., the influence of the laser energy on texture effects and phase formation, are discussed.

Innovative Aspect(s) :
The paper describes Ti|Nb|Ta alloys for use in orthopedic and dental implants. The materials have the highest level of biotolerance, are non-toxic and non-allergenic. Compared to standard materials, they have very high elasticity and high strength. The microstructure can be specifically adjusted by varying the chemical composition. The mechanical properties of one of the alloys presented can be varied in a targeted manner by using different 3D-printing parameters. Even when printing at full density, strengths and elongation at failure can be specifically adjusted over a larger range, which enables the production of implants with graded mechanical properties.

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 : P07
ID : 6274806

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Characterisation and Properties

Author : Ing Azpeleta Gabilondo Maria (Ikergune A.I.E., Spain)

Co-author(s) : Ing Montoya Diego (Ikergune A.I.E., Spain); Ing Alvarez Piera (Ikergune A.I.E., Spain); Ing Ortiz Igor (Ikergune A.I.E., Spain); Ing Arizmendiarrieta Asier (Ikergune A.I.E., Spain)

Title : Study Of The Influence Of The Porosity Of Stellite 6 Powder On The Microstructure And Wear Properties Of Coatings Proceddes By Laser Cladding Technology

Keyword(s) :
Laser Cladding, Porosity, Stellite 6, Manufacture Powder Metal, Wear Properties

Abstract :
In the context of large-scale part manufacturing with laser cladding technology, the quality of the raw material conditions the quality of the coatings produced with this technology. However, the relationship between the quality of the metal powder and the final properties of the manufactured parts has been poorly studied. As a response to such shortcoming, in this paper, we study the influence of the porosity of Stellite 6 powder on the microstructure and wear properties of laser cladding coatings. We compare two batches from different suppliers with a noticeable difference in the porosity levels. We manufactured 3 prisms with each batch under the same processing conditions. The results of our experiments show that powder with higher porosity level generates coatings with higher porosity levels influencing the microstructure and wear properties of the final part. These results also highlight the need for common quality standards on the powder feedstock.

Innovative Aspect(s) :
One of the variables that affect the quality of a manufactured part is the raw material. In the laser cladding process, the current studies of the powder metal feedstock analyze factors, such as porosity, particle size distribution, particle morphology, and rheological properties. However, there is not much information about the influence that these variables have on the final part. In this study, we establish a relationship between the porosity of Stellite 6 powder, and (i) the wear properties and (ii) porosity of the parts manufactured via laser cladding. We analyze two batches of Stellite 6 powder from different suppliers. We measure and compare their significant characteristics. We manufacture 3 prisms of dimensions 40mm x 50mm x 11mm with each batch using the same processing conditions. We compare the microstructure and wear properties of these parts, thus relating the characteristics of the metal powder with the final characteristics of the parts.

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 : P08
ID : 6277177

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Characterisation and Properties

Author : Dr Ing Brabie Liviu (Swerim AB, Sweden)

Co-author(s) : Prof Dr Hryha Eduard (Chalmers University of Techology, Sweden); Dr Ing Strondl Annika (Swerim AB, Sweden); Dipl-Ing Kazi Sofia (Chalmers University of Techology, Sweden); Dr Ing Mellin Pelle (Swerim AB, Sweden); Dr Ing Fedina Tatiana (Swerim AB, Sweden); Dr Ing Leach Lindsay (Alfa Laval Technologies AB, Sweden)

Title : Recycling Of 316 L Powder And Scrap From Additive Manufacturing Processing

Keyword(s) :
316 L Powder, Scrap, Melting, Induction Furnace, Atomization, PBF-LB, Additive Manufacturing

Abstract :
This study focuses on advancing the sustainability of powder-based metal additive manufacturing (AM), with focus on powder bed fusion – laser beam (PBF-LB). As a result of numerous reuse cycles during PBF-LB, powder degradation occurs due to the spatter accumulation and hence increase in bulk oxygen content. Hence, heavily recycled 316L powder and scrap material from PBF-LB processing (support structures, failed components, etc.) were re-melted, followed by detailed SEM+EDX characterization of the ingots. High-pressure gas atomization trials for 316L material were performed at Swerim AB. Powder produced was sieved to PBF-LB size fraction (15-45 µm) and has a total oxygen content of 234 ppm, characterized by excellent processability by PBF-LB. Subsequent examination of powder and component characteristics before and after re-atomization was performed to evaluate change in powder characteristics and properties of as-build material for reused and recycled powders. Results indicate high potential for powder recycling in case of 316L.

Innovative Aspect(s) :
Here are the innovative aspects highlighted in the study: Potentially offering economic benefits by reducing the dependency on new powder production and minimizing material waste. Evaluating the characteristics of both the powder and the as-built components before and after re-atomization.Providing insights into changes in powder properties and the resulting material properties when using recycled and re-atomized powders. Detailed SEM+EDX (Scanning Electron Microscopy + Energy-Dispersive X-ray Spectroscopy) characterization of the re-melted ingots to provide a comprehensive understanding of the material inclusions and its elemental composition.

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 : P09
ID : 6277018

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Characterisation and Properties

Author : Mr Gaillard Gilles (Université Grenoble Alpes - CEA-LITEN, 17 rue des Martyrs, F-38054 Grenoble Cedex, France)

Co-author(s) : Mr Soulier Mathieu (Université Grenoble Alpes - CEA-LITEN, 17 rue des Martyrs, F-3854 Grenoble Cedex, France); Dr Flament Camille (Université Grenoble Alpes - CEA-LITEN, 17 rue des Martyrs, F-3854 Grenoble Cedex, France); Mr Faucherand Pascal (Université Grenoble Alpes - CEA-LITEN, 17 rue des Martyrs, F-3854 Grenoble Cedex, France)

Title : Effect Of Powder Variability (batch Variability, Reuse And Storage) In A Laser Powder Bed Fusion Process

Keyword(s) :
Additive Manufacturing, Laser Powder Bed Fusion, Powder Effect, Variability, Reuse, Storage

Abstract :
Powder characteristics in a laser powder bed fusion (LPBF) process have a major impact on the quality of the parts produced. An in-depth study of the effect of powder properties on the characteristics of LPBF-densified materials was done on two alloys (titanium and aluminum). Both powders were processed from a wide range of conditions in order to determine their induced effects: fresh powder with batch variability at specification thresholds (composition), powder after multiple reuses according to industrial practices and powder after two years of storage. Regardless of the studied configuration, the powders and the LPBF-densified materials were subjected to physical, chemical, microstructural and mechanical analyses. The study of the significant effects of the powder characteristics on their use in LPBF process and on the properties of the printed parts led to define recommendations for the supply, reuse and management of storage with the aim of optimizing production costs.

Innovative Aspect(s) :
We propose in this work a very complete experimental campaign whose result is the understanding of the effect of a powder on the LPBF process from the whole spectrum of powder types that can be found: fresh powder, reused powder and stored powder in industrial conditions. For each of these configurations, the same initial batch of powder is used and the manufacturing is similar for rigorous type-to-type comparison. The comparison is systematic since it is based on the same characterizations (physical, chemical, microstructural, roughness and mechanical). The results give a comprehensive overview of the significant powder parameters on the LPBF process. The conclusions give a necessary perspective of the levers available to optimize production costs, which will contribute to make the additive manufacturing industry competitive.

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 : P10
ID : 6278563

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Characterisation and Properties

Author : Mr Sajithkumar Ananthakrishna (Eurecat, Centre Tecnològic de Catalunya, Spain)

Co-author(s) : Dr Pijuan Jordi (Eurecat, Centre Tecnològic de Catalunya, Spain); Dr Niubó Maria (Universitat Politècnica de Catalunya, Spain); Dr Chen Yunhui (Royal Melbourne Institute of Technology, Australia); Prof Dr Easton Mark (Royal Melbourne Institute of Technology, Australia)

Title : Insights Into Atomization Parameters And Aluminium Alloy Powder Quality In Centrifugal Atomization

Keyword(s) :
Centrifugal Atomisation, Aluminium Alloy, Powder Characterisation

Abstract :
Centrifugal atomization efficiently produces spherical metal powders. This work examines the quality of Al6060 alloy powders with varied process parameters produced by this technique. Although less understood, internal porosity in metal powders is crucial in determining quality in metal additive manufacturing (AM). Synchrotron X-ray micro-CT is employed in this work to understand the sphericity and the internal porosity of metal powders at the individual particle level. Results from these analyses shed light on the intricate relationship between pore and particle morphology and key atomisation parameters. This helps in enhancing the powder performance during metal additive manufacturing.

Innovative Aspect(s) :
The novelty of this work lies in the production of aluminium alloy powder using rotating disc centrifugal atomisation and the application of synchrotron X-ray micro-CT to comprehend internal pores within the produced powders. These methodologies enhance our understanding of pore characteristics in connection with key atomisation parameters, thereby facilitating the optimized production of high-quality aluminium alloy powders for metal additive manufacturing 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 : P11
ID : 6281050

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Characterisation and Properties

Author : Mr Alagha Ali (McGill University, Canada)

Co-author(s) : Ms Rossier Mathilde (University of Applied Sciences and Arts Western Switzerland, Switzerland); Mr Galindo Emilio (McGill University, Canada); Dr Conlon Martin (Equispheres Inc., Canada); Dr Muñiz José (Equispheres Inc., Canada); Dr Azari Kamran (Equispheres Inc., Canada); Dr Butler-Jones Evan (Equispheres Inc., Canada); Dr Brochu Mathieu (McGill University, Canada)

Title : Surface Chemistry Assessment Of Aluminum-Based Alloy Powders Through Triboelectric Charging

Keyword(s) :
Triboelectric Charging, Powder Characterization, Surface Chemistry

Abstract :
In powder bed additive manufacturing processes, factors like moisture, oxidation, and surface contamination can impact powder cohesion, leading to flow behavior degradation and ultimately part quality-related issues. Unfortunately, most of the existing powder characterization tools are either time-consuming|expensive to run or lack the required sensitivity to precisely assess variations in powder surface conditions. Triboelectric charging, a phenomenon resulting from the contact and separation of materials, has recently gained attention as a method allowing differentiation of powder surface composition. Several powder characteristics including particle size, morphology, and surface composition highly influence triboelectric charging. The focus of this presentation is to highlight the effect of surface chemistry on the triboelectric charging behavior of various aluminum alloy powders. This presentation will show the links between tribocharging response of various powders and their X-ray photoelectron spectroscopy (XPS) signature, to demonstrate how tribocharging can be used as a quick method to characterize powder surfaces.

Innovative Aspect(s) :
This work applies triboelectric charging as a rapid and sensitive method for characterizing the surface chemistry of aluminum alloy powders. Unlike traditional time-consuming|expensive techniques, triboelectric charging offers a quick assessment of powder surface conditions. The presentation establishes correlations between triboelectric charging responses and surface properties of aluminum-based powders, providing a scientifically validated link between surface chemistry and triboelectric behavior.

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 : P12
ID : 6281053

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Characterisation and Properties

Author : Dr Jandaghi Mohammadreza (Linköping University, Sweden)

Co-author(s) : Dr Moverare Johan (Linköping University, Sweden)

Title : Investigating The Influence Of Powder Recycling On Microstructural Characteristics And Mechanical Performance Of Additively Manufactured 316L Stainless Steel

Keyword(s) :
Reused Powder, Delta Ferrite, Mechanical Performance, Oxide Particles, Austenite

Abstract :
Reusing powders in laser powder bed fusion (LPBF) is critical for minimizing powder consumption, production costs, and time. Understanding how feedstock properties change with reuse and their impact on build mechanical performance is crucial. In this study, 316L stainless steel powder undergoes 10 reuses. Results reveal that recycled powder contains more satellite and (Si, Mn)-based oxides on particle surfaces. Oxygen pickup is inevitable during solidification in the chamber atmosphere. Some reused particles exhibit a single-crystal ferrite-like structure due to rapid solidification of small spatter droplets. As-received powder is mostly austenitic, while recycled powder has considerable delta ferrite. Pushing oxides to melt pool bottoms during printing of reused powders creates ferritic zones at pool borders. Mechanical strength in samples printed with recycled powder is comparable to those with virgin powders, with a slight elongation decrease attributed to the weak oxide-matrix interface.

Innovative Aspect(s) :
Comprehensive Characterization of Virgin and Recycled Powders through SEM and EBSD Analysis.In-depth Analysis of the Microstructures in Printed Samples Utilizing Virgin and Recycled Powders, Employing XRD and Microscopy Investigations.Investigation of the Correlation Between Microstructural Evolutions and Mechanical Performance in the Examined Samples.

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 : P13
ID : 6280818

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Characterisation and Properties

Author : Mr Rahimi Ehsan (Additive Manufacturing Solutions Ltd, United Kingdom)

Co-author(s) : Mr Higham Robert (Additive Manufacturing Solutions Ltd, United Kingdom); Mr Parry Nick (Materials Processing Institute, United Kingdom); Ms Ingleson Lauren (Additive Manufacturing Solutions Ltd, United Kingdom)

Title : A Dynamic Reusability Strategy Using Track Record Of Process And Powder Identity To Enhance Resource Efficiency Of Powder Bed AM

Keyword(s) :
Powder Reusability, Powder Characterisation, Laser Powder Bed Fusion, Resource Efficiency

Abstract :
This study is a part of a research project (SMART-APP) with the aim of creating a market-ready material management solution to enable laser powder bed fusion (L-PBF) to be used more resource efficiently. SMART-APP proposes a reusability strategy using a physical model based on the material-to-process analysis integrated with an artificial intelligence platform. This research focuses on the physical model to determine powder aging and re-processability. The model uses characterisation inputs of virgin powder to predict the product performance. A new methodology correlating morphology and flowability was first introduced at Euro PM 2023 (the Morflow index). A more advanced correlation is developed through a set of similar indices (Morflow 2.0). The lab-scale model was implemented on a large scale to examine its applicability for common alloys and then adjusted to account for costing parameters. This upgraded methodology provides L-PBF users with a powder aging matrix and a reusability plan.

Innovative Aspect(s) :
Materials efficiency and resource management is a development gap within the AM industry. To enhance sustainability, monitoring the powder quality in each reuse cycle is of high importance. This work is linked to a core research project (SMART-APP) to implement a versatile and commercial artificial intelligence (AI) platform that provides the L-PBF users with a reusability strategy. The AI platform will be a smart predictive tool based on scientific studies to predict powder performance and reusability (The Morflow index presented at World PM 2022 and Euro MAT 2023, and Euro PM 2023). In this series of works, the developed methodology was advanced to include more critical physical and chemical parameters. The predictive tool for powder performance was then validated by mechanical properties of the final products and a reuse strategy was proposed. In a further development, lifecycle assessment factors and powder costing parameters are added to the predictive tool.

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 : P14
ID : 6281583

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Characterisation and Properties

Author : Dr Jokiaho Tuomas (VTT Technical Research Centre of Finland Ltd., Finland)

Co-author(s) : Mr Antikainen Atte (VTT Technical Research Centre of Finland Ltd., Finland); Mr Lindroos Tomi (VTT Technical Research Centre of Finland Ltd., Finland); Mr Lagerbom Juha (VTT Technical Research Centre of Finland Ltd., Finland)

Title : Control Of Nitrogen In Additive Manufacturing Of Austenitic Nickel Free Stainless Steel

Keyword(s) :
Nitrogen, Additive Manufacturing, Austenitic Stainless Steel, Nickel Free, Direct Energy Deposition

Abstract :
Nitrogen alloyed austenitic stainless steels are known for their corrosion resistance, mechanical properties, and stable non-magnetic nature. As long as the nitrogen content remains within certain limits, increasing the nitrogen content generally improves all the said properties. However, if the nitrogen content is increased up to a too high level, ductile to brittle transition may take place The correct level of nitrogen is determined by other alloying elements that can have a role in stabilizing the austenite and increasing nitrogen solubility in the melt during manufacturing. In this research, we investigate how to control the nitrogen content of nominally Fe-16Mn-14Cr-0.27C-0.35N steel during direct energy deposition processing using mixtures of nominal and nitrided powders. An emphasis is placed on the corrosion and mechanical properties of the resulting chemical composition and microstructure.

Innovative Aspect(s) :
Innovative aspect of this study is to be able to control nitrogen content in austenitic stainless steels during direct energy deposition processing. By using mixtures of nominal and nitrided powders, the study aims to optimize nitrogen levels for corrosion resistance and mechanical properties. Focus is also on avoiding the ductile to brittle transition that occurs at excessively high nitrogen levels. The research presents how the nitrogen levels can be controlled during manufacturing and also emphasizes the consequential impact on microstructure and corrosion resistance. Study offers potential advancements in the manufacturing of nitrogen alloyed austenitic stainless steels with improved properties, and therefore enhanced materials in various 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 : P15
ID : 6281401

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Characterisation and Properties

Author : Dr Ing Mellin Pelle (Swerim AB, Sweden)

Co-author(s) : Dr Ing Nilsson Åhman Hanna (Swerim AB, Sweden); Dr Ing Fedina Tatiana (Swerim AB, Sweden)

Title : Toxicity Tests On Respirable Powder Particles, Extracted Using Air Classification From L-PBF Powders

Keyword(s) :
EHS, Cytotoxicity, Powder, L-PBF, Characterization

Abstract :
Concerns remain regarding the health implications of handling fine metal powders. Existing regulations such as occupational exposure limits, are too blunt and does not guarantee safety in working environments.To understand the health impact better, airborne particles were captured in several workshops. Most 0-10µm powder particles are typically removed from as-atomized powders before being sold as L-PBF powders. Still, we found airborne 0-10µm powder particles in all workshops, which are considered respirable.For cytotoxicity tests, we extracted 0-10µm powder particles from L-PBF powders, using an AC1000G screenless air classifier from Blue Power. No cytotoxicity was noted. Furthermore, their size and physio-chemical characteristics were correlated with metal release in artificial lysosomal fluid. Results revealed a notable difference between the whole L-PBF fraction and extracted 0-10 µm particles.Finally, new recommendations for working with powdered materials will be outlined. This includes relevant health checkups, as well as minimizing emissions at their source.

Innovative Aspect(s) :
Powder-based metal additive manufacturing has reached considerable maturity. However, the industrial implementation remains limited. One factor expressed by several industries is the concerns regarding the health and safety implementation of powder-based AM workspace where powdered metals have not been previously handled.In this study, carried out with 24 Swedish companies, these health and safety implications have been thoroughly addressed, on a larger scale than previously, to get an important insight into which materials and in which form these materials could be harmful.

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 : P16
ID : 6281695

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Characterisation and Properties

Author : Mr Cogotti Andrea (Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM, Germany)

Co-author(s) : Dr Hein Sebastian Boris (Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM, Germany); Ms Reineke Lea (Fraunhofer Institute for Manufacturing Technology and Advanced Materials IFAM, Germany)

Title : Powder Emissivity And Its Correlation With The Quality Of Printed Parts In Metal Binder Jetting

Keyword(s) :
Metal Binder Jetting, Powder Emissivity, Powder Bed Temperature

Abstract :
Metal Binder Jetting has become an established manufacturing process for serial production in recent years. Therefore, it is crucial to ensure the repeatability and qualification of the process for different materials. An infrared lamp is used to warm the powder bed during the process, causing the solvent in the binder to evaporate. The temperature of the lamp is controlled by an infrared sensor. To accurately measure the temperature of a powder bed, and thus being able to ensure proper process control, it is necessary to know the emissivity value of the metal powder. This study determined the emissivity value for various powders and compared the properties of green parts, printed with the correct emissivity to those printed without prior determination.

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 : P17
ID : 6282011

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Characterisation and Properties

Author : Miss Kazi Sofia (Chalmers University of Technology, Sweden)

Co-author(s) : Dr Leach Lindsay (Alfa Laval Technologies AB, Sweden); Prof Hryha Eduard (Chalmers University of Technology, Sweden)

Title : Changes In Powder Surface Chemistry During Reuse Of 316L In Powder Bed Fusion - Laser Beam

Keyword(s) :
Powder Degradation, Surface Chemistry, Oxide Layer Thickness, Powder Reuse, PBF-LB, 316L

Abstract :
Powder degradation during additive manufacturing poses a significant challenge to achieving optimal part quality as well as maximal powder feedstock utilization and hence economy and sustainability of the process. Stainless steel 316L is a widely utilized material in powder bed fusion – laser beam (PBF-LB) due to its excellent processability, good corrosion resistance and mechanical properties of the PBF-LB processed components. This study investigates the influence of 316L powder properties and powder reuse on the powder surface oxide chemistry and hence processability by PBF-LB. Changes in powder surface chemistry were studied by HR SEM and X-ray Photoelectron Spectroscopy in virgin and reused state. Results indicate that there is evident degradation in powder properties during powder re-use with increase in oxygen content in the powder, connected to increase in iron-base surface oxide layer as well as Cr-reach particulate oxide phases.

Innovative Aspect(s) :
Aid in optimization of 316L powder feedstock utilization, one of the most commonly used materials in PBF-LB. Pushing the boundaries of reuse will create oportunities for a more sustainable and cost firendly 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 : P18
ID : 6282638

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Characterisation and Properties

Author : Dr Ing Gobber Federico Simone (Politecnico di Torino, Italy)

Co-author(s) : Ing Lupi Giorgia (Politecnico di Milano, Italy); Ing Pennacchio Antonio (Politecnico di Torino, Italy); Ing Ceroni Marta (Politecnico di Torino, Italy); Prof Dr Actis Grande Marco (Politecnico di Torino, Italy); Prof Dr Casati Riccardo (Politecnico di Milano, Italy)

Title : Production Of High Silicon Aluminium Powders With Tailored CTE

Keyword(s) :
Hypereutectic AlSi Powders, Alloy Design, Powder Characterization, Processability

Abstract :
In recent years, Laser Powder Bed Fusion (L-PBF) has emerged as a promising alternative manufacturing technique for hypereutectic Al-Si alloys. Aluminium alloys containing high silicon are of special importance in terms of thermal management applications owing to their low density, high thermal conductivity and tailorable coefficient of thermal expansion (CTE). In this work an alloy design, backed by thermodynamic simulation to determine the effect of alloying elements on CTE and phase stability, was carried out with the aim of reaching a CTE value compatible with that of the standard Ni plating. Following the results of simulation, hypereutectic AlSi powders were produced by gas atomizing. Powders were characterized in terms of microstructure (by SEM, EDX, and XRD), granulometry, rheology and laser absorbance by UV-Vis-NIR. Powders were then processed with conventional L-PBF system.

Innovative Aspect(s) :
The alloy design of a Al-based powder system with targeted properties in terms of thermal expansion; The development of proper gas atomization to achieve spherical powder with proper particle size distribution for the target AM processes and high production yield; The characterization of the powder by the evaluation of the laser absorbance by means of UV-Vis-NIR.

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-P19
ID : 6280486

Requested presentation type : Poster Presentation

Topic : Powders **Subtopic :** Powder Characterisation and Properties

Author : Dr Brant de Campos Jose (Rio de Janeiro State University, Brazil)

Co-author(s) : Miss dos Santos Kelen Venancio (Rio de Janeiro State University, Brazil); Miss Pelicarto Alves da Silva Botão Camila (Rio de Janeiro State University, Brazil); Dr de Souza Baêta Júnior Eustaquio (Rio de Janeiro State University, Brazil); Dr dos Santos Aguilera Leticia (Rio de Janeiro State University, Brazil); Dr Bottega Peripolli Suzana (Rio de Janeiro State University, Brazil); Dr Massa Fernandes Fernando (UC Louvain, Belgium)

Title : Lead Sulfide Nanoparticles (Pbs): Preparation And Characterization

Keyword(s) :
Sensor Devices Applications, Nanomaterials, Synthesis, Characterization

Abstract :
PbS is a semiconductor and semiconductor nanoparticles have been shown to be promising in applications such as microelectronics, optoelectronics and optics, and can be also useful in electroluminescent devices such as light-emitting diodes. When the crystal sizes are smaller than the Bohr radius, the exciton becomes confined in all three spatial directions, a phenomenon called the quantum confinement, becoming an interesting system to study this effect, since optical and electronic properties of materials are size dependent of the particles [1]. The use of an aqueous synthesis in 2-mercaptoethanol is an alternative to standard synthesis, which uses Oleic Acid (OA). In this work, the synthesis route for the production of PbS nanoparticles was evaluated through characterization by Scanning Electron Microscopy (SEM) and Transmission Electron Microscopy (TEM) to investigate the distribution, morphology and size of the nanoparticles, as well as X-ray Diffraction (XRD) to confirm that the phase formed (PbS).

Innovative Aspect(s) :
The present work is innovative since it has used a alternative route for PbS nanoparticle synthesis and also, the focus of the material characterization is the control of the product aspect for sensoring 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 : P-P20
ID : 6281184

Requested presentation type : Poster Presentation

Topic : Powders **Subtopic :** Powder Characterisation and Properties

Author : Prof Dr Mashhadikarimi Meysam (Universidade Federal Do Rio Grande Do Norte-UFRN, Brazil)

Co-author(s) : Mrs Samara Vieira Pâmala (Universidade Federal Do Rio Grande Do Norte, Brazil); Mr Costa Marques Anderson (Universidade Federal Do Rio Grande Do Norte, Brazil); Mr Dos Santos Vasconcelos Gabriel (Universidade Federal Do Rio Grande Do Norte, Brazil); Mr Marques dos Santos Lucas (Universidade Federal Do Rio Grande Do Norte, Brazil); Mrs Queiroz e Silva Thalita (Universidade Federal Do Rio Grande Do Norte, Brazil)

Title : Impact Of WC Addition And High-energy Milling Time On The Properties Of Cu-WC Composite Powders

Keyword(s) :
High Energy Milling, Cu-WC Composites, Copper Powder Hardening, Powder Microhardness

Abstract :
Composites formed by a copper matrix, reinforced by a ceramic and refractory material, stand out due to their relevance in electrical conductor applications. In this context, this study investigated the hardening of copper powder with the addition of different concentrations of tungsten carbide (5, 10, 15 and 20% by weight) prepared by high-energy milling (HEM) for 1, 2, 5, 10 and 20 hours. The powders were characterized by SEM, XRD and Vickers microhardness. The results showed that the milling method was efficient for obtaining Cu-WC composites, with strong bonds between the phases. The diffractograms showed characteristic copper and tungsten carbide peaks, with no secondary phases. The Vickers microhardness value is directly related to the amount of WC and the milling time, consequently, the 20% WC composite powder milled for 20 hours had a hardness of 250.50 HV, exceeding the values of the other powders.

Innovative Aspect(s) :
The innovation of this study is to analyze the production of Cu-WC composite material, with varying concentrations of WC reinforcement and different high-energy milling times. Vickers Microhardness testing is conducted on the composite powders to analyze the effect of WC content and milling time on the material's hardness. The resulting composites exhibit excellent thermal and electrical properties, along with robust resistance to mechanical wear, making them highly suitable for using in the electrical contact industry. Potential applications include switches, circuit breakers, electric motors, and power distribution systems. In manufacturing context, studies obtaining and characterizing composite powders are crucial to define and structure the processing stages, with the end goal of determining the ideal composition and best milling times. The ultimate objective is to obtain a material that not only has high electrical conductivity but also high mechanical resistance, thereby rendering its application in electrical systems feasible.

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-P21
ID : 6281454

Requested presentation type : Poster Presentation

Topic : Powders **Subtopic :** Powder Characterisation and Properties

Author : Dipl-Ing Ravi Soundariya (Institute of Materials Research of Slovak Academy of Sciences, Slovakia)

Co-author(s) : Dr Ing Bures Radovan (Institute of Materials Research of Slovak Academy of Sciences, Slovakia); Dipl-Ing Faberova Maria (Institute of Materials Research of Slovak Academy of Sciences, Slovakia); Dr Bircakova Zuzana (Institute of Materials Research of Slovak Academy of Sciences, Slovakia); Dipl-Ing Kostiuk Vladyslav (Institute of Materials Research of Slovak Academy of Sciences, Slovakia)

Title : Geometric Microstructural And Functional Properties Of Mechanically Modified FeSiAl Soft Magnetic Powders

Keyword(s) :
Soft Magnetic Composites, Ball Milling, Resonant Acoustic Mixing, Spherical And Flaky Ferromagnetic Particles, Compressibility, Electromagnetic Properties

Abstract :
Soft magnetic composites are materials based on ferromagnetic particles surrounded by secondary electrical insulating components. The geometric size&shape of the ferromagnetic particles are crucial for the functional properties of consolidated SMC materials. Modern electronic and engineering applications create pressure for the development of materials applicable at increasingly higher frequencies of alternating magnetization. An increase in the frequency stability of the magnetic properties can be achieved by reducing the size of the ferromagnetic particles and|or by increasing the thickness of the electrical insulation layer. In any case, permeability and magnetic flux density decrease. The subject of this research is the preparation of FeSiAl particles realized by several methods of resonant acoustic and ball milling. Spherical and flake-like ferromagnetic particles with different distributions of Si and Al were prepared. Coercivity and permeability as well as changes in density and compressibility were studied depending on the structural and geometrical characteristics of the powders.

Innovative Aspect(s) :
The mechanical modification of powder particles, in which, in addition to a change in shape and size, also a purposefully heterogeneous distribution of elements occurs, provides great possibilities for the preparation of magnetically soft powder particles. Si and Al increase the resistivity of the Fe surface parts. The gradient structure of the particles has the potential to increase the resistivity with a not too dramatic decrease in permeability as opposed to simply increasing the thickness of the electro-insulating layer. Optimizing the geometric shape and distribution of resistivity-enhancing elements can partially preserve the formability and compressibility of the alloy. Methods of resonant acoustic milling and oscillating-planetary milling were compared from the viewpoint of effectivity to achieve the required size, shape and chemical composition of FeSiAl particles as well as magnetic properties of mechanically modified materials for fabrication of SMC for high-frequency 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

Technical Programme Committee
8th of February 2024

POWDERS

POWDER PRODUCTION

EPMA
european powder metallurgy association

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

Paper Number : P22
ID : 6251254

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Production

Author : Dr Altenberend Jochen (Tekna Plasma Europe, France)

Co-author(s) : Ing Bailly Ophélie (Tekna Plasma Systems Inc, Canada); Dr Cabrol Elodie (Centrale Lyon ENISE | LTDS, France); Dr Dolbec Richard (Tekna Plasma Systems Inc, Canada); Ing Si Mohand Hocine (Centrale Lyon ENISE | LTDS, France); Ing Van Wijk Pierre (Tekna Plasma Europe, France); Dr Vert Romain (Tekna Plasma Europe, France)

Title : Recycling And Reconditioning Of Additive Manufacturing Metallic Powders By RF Plasma Treatment

Keyword(s) :
Recycling, Sustainability, RF Plasm, Spheroidization, Deoxidation, Sphericity, Morphology

Abstract :
In most additive manufacturing (AM) processes, a significant fraction of the non-consolidated powder can be reintroduced into the process. However, after several cycles, altered flowability and|or oxygen pick up make such powders unsuitable for their reuse so that they become waste material. Radio Frequency (RF) plasma treatment can increase the flowability of these powders and for many materials it can even reduce oxygen content. As a result, powders initially considered as waste can now be transformed into high quality powders. In this study we review the literature related to RF plasma treatment for powder recycling and powder reconditioning and the physical and chemical phenomena are discussed. The limits and opportunities for the use of RF plasma for powder reconditioning of different materials are deduced.

Innovative Aspect(s) :
Currently large amounts of end of life powder used in additive manufacturing are discarded as waste material because of high oxygen content or poor morphology. The review of literature results and unpublished Tekna internal results show that many of these powders can be reconditioned by reducing the oxygen content and improving the morphology so that they can be reused.

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 : P23
ID : 6256374

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Production

Author : Mrs Boualouache Salima (Université de téchnologies de Belfort Montbéliard, France)

Co-author(s) :

Title : Study Of Oxide Nanoprecipitate Formation Mechanisms In 316 L Stainless Steel Produced By Rapid Solidification Processes: Gas Atomization And Laser Powder Bed Fusion (L-PBF)| Effect On Impact Toughness

Keyword(s) :
Rapid Solidification, Nanoprecipitates, Atomization, SLM (Selective Laser Melting), Impact Toughness

Abstract :
AM materials tend to have a lower toughness compared to those produced using conventional processes (casting, forging) [1]. The decrease in impact strength is attributed to the presence of nano-oxides rich in silicon Si and manganese Mn on the fracture surfaces [1]. The objective of this work is to characterize the nanoprecipitates in both the 316L powder particles elaborated by gas atomization (GA) and in the components manufactured using Laser Powder Bed Fusion (L-PBF) with these powders. These two processes (GA and L-PBF) have high solidification rates, which could allow to identify the segregation mechanisms of oxide nanoprecipitates. Charpy impact tests will be conducted to confirm the influence of these nanoprecipitates on the reduction in impact resistance.[1].Lou, P. L. Andresen, et R. B. Rebak, « Oxide inclusions in laser additive manufactured stainless steel and their effects on impact toughness and stress corrosion cracking behavior », J. Nucl. Mater., vol.

Innovative Aspect(s) :
The study brings attention to the previously neglected impact toughness of 316L stainless steel parts produced via additive manufacturing (AM). It underscores the existence of nano-oxides, abundant in silicon and manganese, linking their presence to decreased impact strength observed on both fracture and powder surfaces. The research aims to explore potential solutions to address this issue, targeting both the powder material and the AM-fabricated 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 : P24
ID : 6268309

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Production

Author : Mr Wilkens Yannik (SMS group GmbH, Germany)

Co-author(s) :

Title : Cost-effective Manufacturing Of Metal Powders Through Continuous Process

Keyword(s) :

Abstract :
Cost-effective and high-quality powders will be one of the main drivers for the development of metal AM towards a sustainable industrial technology.In addition to conventional gas atomization plants another innovative powder production process has been developed together with a customer. The conventional batch-wise process is transformed into a continuous process. The continuous powder production plant enables cost-effective and large-scale production of up to 4,000 tons per year. Compared to the traditional gas atomization process the capacity is increased by a multiple. Production costs for spherical, high-quality metal powders are significantly reduced. The increase in capacity results in enormous economies of scale. Set-up times, melting and cooling times are reduced. In the new process, two vacuum induction melting (VIM) furnaces continuously hold liquid melt, which is atomized successively through the nozzle. The nozzle can be exchanged during operation. Melting is done under vacuum to guarantee highest quality levels.

Innovative Aspect(s) :
New innovative process, Batch gas atomization is transfered to a continuous process with high capacities, Potential to reduce powder costs significantly

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 : P25
ID : 6269737

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Production

Author : Ing Meyer Philipp (Neue Materialien Bayreuth GmbH, Germany)

Co-author(s) : Dr Ing Schwarte Stefan (Jäkel GmbH & Co. KG, Germany); Ing Daniel Riehle (K.U.L.T. Kress Umweltschonende Landtechnik GmbH,, Germany); Prof Dr Glatzel Uwe (University Bayreuth - Chair of Metals and Alloys, Germany); Dr Ing Daoud Haneen (Neue Materialien Bayreuth GmbH, Germany)

Title : Novel Method For Manufacturing Of WC-based Metal Matrix Composites By Wire Arc Thermal Spray

Keyword(s) :
Tungsten Carbide, Powder Atomization, Spherical Powder, Wear Resistance

Abstract :
Metal matrix composites (MMC) promote high wear and temperature resistance for various applications. The desired tribological, mechanical or thermal properties of MMC components can be specifically adjusted by an optimal combination of metallic matrix and reinforcement particles. Tungsten carbide (WC) reinforced powders for additive manufacturing are produced by premixing of both reinforced particles and matrix particles. However, due to the density differences of the two phases and the dissolution effect of WC-particles under high temperature, manufacturing of homogenous MMC-components is still challenging. In this study, a new approach to produce homogeneous, with high wear resistance WC-M powder is proposed. Therefore, cored WC-wires are atomized by newly developed wire arc thermal spray atomization method. The powders were characterized to surface morphology, particle size distribution and dissolution behavior of WC particles. The influence of atomization parameters and the use of different metal matrix materials will be discussed.

Innovative Aspect(s) :
Production of spherical MMC powders based on tungsten carbide with a M-based matrix. The powders have a macroscopic second phase inside in the form of tungsten carbide. By coating the carbide with the matrix, conventional manufacturing problems can be solved. The atomization also leads to a spherification of the carbide, which results in higher wear resistance and hardness.

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 : P26
ID : 6278515

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Production

Author : Dr Ing Seeliger Hans-Wolfgang (Gränges Powder Metallurgy, Germany)

Co-author(s) : Dr Neu Tillmann (Institute for Applied Materials, Helmholtz Zentrum Berlin for Materials and Energy, Germany); Dr Garcia-Moreno Francisco (Institute for Applied Materials, Helmholtz Zentrum Berlin for Materials and Energy, Germany); Dr Kamm Paul (Institute for Applied Materials, Helmholtz Zentrum Berlin for Materials and Energy, Germany)

Title : Aluminium Scandium Powder Alloy Development For Hydrogen Storage Valve

Keyword(s) :
Aluminium Scandium Alloy Powder, Additive Manufacturing, Save Scandium Source, Hydrogen Storage Valve, Spray Forming

Abstract :
Scandium additions of typically up to 0.2 wt% in wrought Al alloys are known to improve their mechanical performance. New sources and process routes for scandium extraction are now being identified and developed. Laser bed powder fusion (LBPF) process is characterized by a rapid solidification, which improves microstructure. The rapid solidification allows for a fine distribution of Sc precipitates. For the production of a hydrogen on-tank valve, various Al alloy with up to 1 wt% Sc and Zr additions were mixed. For that purpose, powder from an of AlSc2 (in wt%) master alloy purchased from Rio Tinto (Canada) was produced and mixed with other elemental and alloy powders to obtain the desired composition. With different compositions parts were produced by LBPF, characterized with optical microscopy, hardness measurements. Their mechanical parameter were evaluated and the results were compared with the state-of-the-art AlSi10Mg alloy.

Innovative Aspect(s) :
First aluminium hydrogen valve from additive manufacturing, New scandium source, Sustainable manufacturing, More secure scandium supply chain, Improved scandium alloy in terms of hydrogen absorption, Optimized processing of components through special tool coating, Materials are manufactured by spray forming, which results in both powder and solid material with a very fine structure in one manufacturing process.

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 : P27
ID : 6277109

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Production

Author : Mr Choma Tomasz (AMAZEMET, Poland)

Co-author(s) : Mr Ciftci Jakub (AMAZEMET, Poland); Mr Moronczyk Bartosz (AMAZEMET, Poland); Mr Kalicki Bartosz (AMAZEMET, Poland)

Title : Alloy Development For Powder Metallurgy Using Ultrasonic Atomization

Keyword(s) :
Atomization, Metal Powders, Alloy Development, Powder Manufacturing

Abstract :
Current methods for the production of spherical powders restrict the development of new chemical compositions dedicated to various powder metallurgy technologies. Ultrasonic atomization process enables in-house powder production starting with single grams up to a few kilograms to verify new alloys. Plasma-based ultrasonic atomization was used to manufacture spherical powder of the high-temperature alloy, while induction-based ultrasonic atomization was used to develop a low-melting alloy. Additional case studies will be presented to provide an overview of the technology possibilities.

Innovative Aspect(s) :
In-house powder manufacturing, Manufacturing of small quantity of metal powders with designed chemical composition

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 : P28
ID : 6279391

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Production

Author : Dipl-Ing Holzer Alexander (TU Wien, Austria)

Co-author(s) : Dipl-Ing Nahringbauer Peter (TU Wien, Austria); Mr Stark Lukas (TU Wien, Austria); Prof Dr Gierl-Mayer Christian (TU Wien, Austria)

Title : Small Batch Powder Production For Additive Manufacturing By Ultrasonic Atomization

Keyword(s) :

Abstract :
Due to the strong dependency on powder supplier, the additive manufacturing is restricted to a small range of materials and connected to big orders. Competitive and profitable production often requires serial production and therefore small products. The powder preparation, starting by producing the desired material composition, allows to design customized powder specialised for each additive application. In our case, ultrasonic atomization realizes batch-wise material research and prevents waste of material. In this work, opportunities and difficulties of the wire-fed ultrasonic atomization process is discussed. The main focus are stainless steels, e.g. 316L and variants, for lithography-based metal manufacturing. Furthermore, the powder characterisation, the tools for adjusting the powder atomization and first steps of additive manufacturing are presented. Results show that ultrasonic atomization provides narrow powder size distribution, almost perfect rounded powder without any satellites.

Innovative Aspect(s) :
Resource-efficient and on-demand batch-wise powder production for additive manufacturing, reproduceable and application-oriented particle-size distribution

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 : P29
ID : 6281563

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Production

Author : Mr König Philip (Ruhr University Bochum, Germany)

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

Title : Nitrogen-Enhanced Martensitic Cr Steel: Advancing Strength, Corrosion Resistance, And Sustainability In Additive Manufacturing

Keyword(s) :
Gas Atomization, Additive Manufacturing, PBF-LB|M

Abstract :
The range of martensitic Cr steels that can currently be processed with PBF-LB|M is considerably limited. In order to expand and optimize the alloy portfolio of this alloy category, the qualification of a corrosion resistant martensitic Cr-steel with good processability for additive manufacturing is the focus of this study. The study covers the entire process chain from alloy development based on X50CrMoV15 steel, powder production via gas atomization, additive manufacturing using PBF-LB|M and microstructural investigations. Nitrogen is the key element in this concept as it can have a positive effect on strength, ductility and corrosion resistance and environmental footprint. In addition, N improves susceptibility to cold cracking in melt based additive manufacturing processes by reducing the MS temperature.

Innovative Aspect(s) :
By introducing nitrogen into the atomization process of a martensitic Cr steel, in addition to better processability using PBF-LB|M and better properties in the manufactured sample, sustainability could be improved in contrast to conventional argon atomization.

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 : P30
ID : 6281664

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Production

Author : Mr Henrichs Julian (Linde GmbH, Linde Technology - Additive Manufacturing & Powder Metals, Germany)

Co-author(s) : Mr Abraham Ajay (Linde GmbH, Linde Technology - Additive Manufacturing & Powder Metals, Germany); Mr Rosenberg Ronald (Linde GmbH, Linde Technology - Additive Manufacturing & Powder Metals, Germany); Mr Forêt Pierre (Linde GmbH, Linde Technology - Additive Manufacturing & Powder Metals, Germany); Dr Ing Giglmaier Marcus (Technical University of Munich; TUM School of Engineering and Design, Chair of Aerodynamics and Fluid Mechanics, Germany); Prof Dr Adams Nikolaus A. (Technical University of Munich; TUM School of Engineering and Design, Chair of Aerodynamics and Fluid Mechanics, Germany)

Title : Investigating The Gas Atomization Nozzles Near-field Gas Flow By Experimentally And Computationally Gained Schlieren Images For Rotationally Symmetric And Planar Symmetric Nozzles

Keyword(s) :
Additive Manufacturing, Gas Atomization, Metal Powder Production, Schlieren Imaging, Gas Dynamics, Primary Atomization

Abstract :
Metal Additive Manufacturing (AM) confronts challenges in achieving cost-effective production of high-quality powder (1-150 µm) due to the intricacies of the gas atomization process. Investigating the fluid dynamics in the nozzle near-field becomes imperative for a comprehensive understanding due to the pivotal role of primary atomization. This study investigates the gas flow of two close-coupled nozzles to investigate this research gap: a traditional 3D rotational symmetric nozzle and a 2D planar-symmetric nozzle mapping the intricate 3D rotational-symmetric gas flow pattern onto a more manageable 2D planar representation.Schlieren images compare both nozzles, once experimentally gained on an industrial-size atomization test bench (ATB) and digitally created from Computational Fluid Dynamics (CFD) simulations. This methodological approach opens new ways to atomization studies by combining experimental and computational approaches. Such insights are vital for propelling advancements in metal AM and offering enhanced precision and control in producing high-quality metal powders.

Innovative Aspect(s) :
Investigation of two individual close-coupled atomization nozzles (A & B) and their gas flows via CFD simulation and experimental validation through an industrial scale atomization test bench (ATB). Nozzle A is a 3D rotational symmetric nozzle comparable to industry standards. On the other hand, nozzle B is a 2D planar symmetric nozzle, which maps the 3D symmetric flow features on a 2D plane. The experimental investigation is performed on an ATB located at Lindes Technology Center in Unterschleißheim, Germany. The ATB combines industrial-scale flow conditions with good optical accessibility and state-of-the-art high-speed Schlieren Imaging equipment.

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 : P31
ID : 6281691

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Production

Author : Dr Ing Marie Antoine (Framatome, France)

Co-author(s) : Dr Ing Bischoff Jeremy (Framatome, France); Ing Nicollet Cedric (Framatome, France); Dr Ing Viry Frederic (Simtec, France); Dr Ing Namy Patrick (Simtec, France)

Title : Modelling Of The UF6 To UO2 Conversion Process

Keyword(s) :
Nuclear Fuel Manufacturing, Ceramic Grade Powder Production, Fuel Pellets, Process Modelling

Abstract :
The ceramic-grade nuclear powder can be produced under two main routes, dry or wet "reconversion" processes, consisting in transforming crystalline UF6 as UO2 powder usable to produce fuel pellets. The dry conversion processes, used in Framatome, are divided in two steps: pyrohydrolysis and reduction by thermal treatments. The process used in Romans manufacturing plant has been studied years ago, but the improvements applied since and the product evolution associated have not been modelled.First, the UF6 to UO2F2 reaction and vessel are being modelled, with as benefits: Better understanding of the process, Set-up parametric tests without using industrial equipment, Development of a numerical twin to be used as a training tool.In a further extent, the purpose is to be able to model the whole reaction vessel and calciner, including the chemical and thermic reactions, in order to correlate the final UO2 properties to the process parameters.

Innovative Aspect(s) :
Chemical reaction modelling; Improvement of process understanding; Set-up of numerical parametric 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 : P32
ID : 6281880

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Production

Author : Dipl-Ing Limberg Wolfgang (Helmholtz-Zentrum hereon GmbH, Germany)

Co-author(s) : Dr Ing Rackel Marcus (Helmholtz-Zentrum hereon GmbH, Germany); Dr Pyczak Florian (Helmholtz-Zentrum hereon GmbH, Germany); Dr Ebel Thomas (Helmholtz-Zentrum hereon GmbH, Germany); Prof Dr Willumeit-Roemer Regine (Helmholtz-Zentrum hereon GmbH, Germany)

Title : Recycled Ti-6Al-4V Powder Processed By Fusion Granulate Fabrication (FGF) And MIM In Comparison To Commercial Plasma Atomized Powder

Keyword(s) :
Recycling, Titanium, Ti-6Al-4V, Metal Injection Molding (MIM), Fused Granulate Fabrication (FGF)

Abstract :
An economic drawback of powder based additive manufacturing methods is the high cost of powder compared to cast materials. However, the use of recycled materials, which do not originate from the primary powder production cycle, offers potential for cost reduction. In the present contribution, the use of Ti-6Al-4V powder generated via recycling is combined with Fused Granulate Fabrication FGF and MIM processing. The starting chip material comes from aviation production leftovers. The cleaned chips were shaped into cylindrical electrodes and spherical powder was produced using the EIGA process. The tensile test properties of the parts made out of the recycled Ti-6Al-4V powder were validated against parts produced from commercial plasma atomized Ti-6Al-4V powder. The parts produced from recycled powder show a higher oxygen content and therefore higher tensile strength but only a little lower plastic elongation to fracture, compared to parts made from plasma-atomized powder.

Innovative Aspect(s) :
The large aircraft structure components found in aviation are now machined from solid material. High machining rates of up to 95% are common. The resulting chip material is usually not recycled in a high-quality manner, but rather fed into less demanding process chains (e.g. as an additive in the steel industry). Nowadays, if Ti-6Al-4V chips are recycled, this is done by multiple vacuum arc remelting.The new process presented here, allows the production of powder directly from the turning or milling chips without prior remelting. This reduces energy consumption on the one hand and the risk of contamination by foreign substances on the other.

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 : P33
ID : 6276453

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Production

Author : Dr Ing Dubiez-Le Goff Sophie (Linde GmbH, Germany)

Co-author(s) : Dr Ing Achelis Lydia (Particles and Process Engineering Department, Faculty of Production Engineering, Universität Bremen, Germany); Dr Ing Beckers Daniel (Rosswag GmbH, Germany); Dr Treuchtlinger Niels (Linde GmnH, Germany); Ing Rosenberg Ronald (Linde GmbH, Germany); Ing Forêt Pierre (Linde GmbH, Germany)

Title : Hot Gas Atomization: A Powerful Solution To Meet AM Powder Requirements

Keyword(s) :
Hot Gas Atomization, 316L Powder, Gas Supply

Abstract :
Enhancing the yield is key for manufacturers of metal powders. To reach smaller particle size distributions, typically suitable for additive manufacturing processes, the common practice is to increase the pressure during gas atomization. If allowed by the equipment, it leads inevitably to higher gas consumption. To tackle this, another approach is to heat the gas. Higher gas temperature increases indeed the gas velocity, which generates bigger gas momentum and kinetic energy for the metal drop break-up. Some input will be given to highlight the importance of customizing the right gas supply and especially the right heater to optimize the operative cost. Small (5kg) and mid-size (15 kg) batches of 316L stainless steel have been manufactured with heated gas and with ambient gas, any other process parameters being constant. Comparative results (particle size distribution, morphology and flowability) will be shared showing the benefit of heating the gas.

Innovative Aspect(s) :
Customization of the gas supply; New results on 316L batches of powder performed with different atomizer to check the impact of the mass of the batch.

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 : P34
ID : 6281374

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Production

Author : Ms Cegarra Sasha (FUNDACIO EURECAT, Spain)

Co-author(s) : Dr Pijuan Jordi (FUNDACIO EURECAT, Spain); Dr Dosta Sergi (Universitat de Barcelona, Spain); Dr Albaladejo-Fuentes Vicente (Universitat de Barcelona, Spain); Prof Dr Riera María Dolores (Technical University of Catalonia, Spain)

Title : Innovations In Centrifugal Atomization: A Focus On Al-Based Metallic Glasses

Keyword(s) :
Centrifugal Atomization, Al-based Metallic Glasses, Powder Production

Abstract :
Centrifugal atomization is a rapid solidification process for producing metal powders traditionally limited to common metals and their alloys. This paper aims to introduce notable modifications in the development of centrifugal atomization as the research shift its focus to the production of novel materials such as metallic glasses. Emphasizing on the process parameters of atomization, mathematical calculations, and powder characterization, this research details the advancements in centrifugal atomization for Al-based amorphous powder production. The suitability of the centrifugal atomization cooling rate values for the production of Al-based metallic glasses was assessed using both theoretical and experimental approaches. This study has been accompanied by a comprehensive SEM, XRD, and DSC characterization analysis of the Al-based metallic glasses powders produced via centrifugal atomization. Overall, this paper summarizes the technical difficulty and application prospects of metallic glasses by centrifugal atomization and discusses the challenges and unresolved problems.

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 : P35
ID : 6282648

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Production

Author : Dr Ing Gobber Federico Simone (Politecnico di Torino, Italy)

Co-author(s) : Prof Dr Actis Grande Marco (Politecnico di Torino, Italy); Prof Dr Priarone Paolo Claudio (Politecnico di Torino, Italy)

Title : An Approach To Evaluate Quality And Sustainability For Powders Produced By A Lab - Scale Atomizer

Keyword(s) :
Gas Atomization, Sustainability, Powder Characterization

Abstract :
Sustainability in production processes is a crucial topic that ensures the responsible use of resources, minimizes environmental impact, fosters long-term viability, and aligns economic success with ecological and social well-being. Regarding powder production via gas-atomization, the main aspects to maximize in order to achieve a robust process are powder quality and powder yield. However, gas-atomization energy consumption varies depending on gas-atomization pressure, heating time, power, and consumable reuse. This study proposes a methodology to optimize gas-atomized powder production by reducing the equivalent carbon generated per kilogram of powder. The methodology incorporates particle size distribution, morphology, and environmental impact considerations. The article reports a comprehensive case study for super-duplex steel powders produced by a lab-scale inert gas atomizer.

Innovative Aspect(s) :
Coupled approach between sustainability and metallurgical|process evaluation; Accurate extimation of equivalent CO2 produced by gas atomization for a specific atomizer

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 : P36
ID : 6282701

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Production

Author : Dipl-Ing Nahringbauer Peter (TU Wien, Austria)

Co-author(s) : Dipl-Ing Holzer Alexander (TU Wien, Austria); Dr Rauchenwald Elisabeth (Huawei Technologies Austria, Austria); Prof Dr Gierl-Mayer Christian (TU Wien, Austria)

Title : Ultrasonic Atomization Of Soft Magnetic Fe-based Alloys

Keyword(s) :
Ultrasonic Atomization, Soft Magnetic Materials, Fe-Alloys, Powder Production, Functional Materials, Powder Characterization

Abstract :
Soft magnetic materials are crucial for efficient energy conversion and transfer in various electrical devices and power systems. For ideal soft magnetic properties such as a high saturation magnetization, low permeability and minimal losses, precise control over the material properties is necessary. In this work, the production of Fe-based soft magnetic alloys is described as a new method to obtain powders with tailored compositions, grain size and morphology. Various production parameters were used to gain insight into their impact on the powder properties, focusing particularly on grain size. Additionally, this research also concentrates on visualizing the atomization process to study the underlying mechanisms. It was found that the ultrasonic atomization can provide highly spherical powders with a narrow grain size distribution while maintaining raw material composition. Therefore, it is suitable for small-batch production of novel soft magnetic powders for research purposes.

Innovative Aspect(s) :
Visualization of Ultrasonic AtomizationRessource-efficient production of novel soft magnetic powders.

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 : P37
ID : 6282819

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Powder Production

Author : Prof Avello Alejo (CEIT and University of Navarra, Spain)

Co-author(s) : Dr Urionabarrenetxea Ernesto (CEIT and University of Navarra, Spain); Dr Martin Jose Manuel (CEIT and University of Navarra, Spain)

Title : CFD Efficient Simulations To Predict Particle Size Distributions Of Gas-atomized Powders Of Different Materials Obtained With Different Gases

Keyword(s) :
Close-Coupled Gas Atomization, CFD Simulation, Metal Powder Production, Atomising Gas

Abstract :
Prediction of particle size distribution (PSD) in close-coupled gas atomization is of great interest to optimize nozzle designs and to accelerate the choice of optimum operating variables in first-time atomizations. Previous works have shown that CFD simulations based on simplifying assumptions can correctly predict trends of median particle size of copper powders produced at different nitrogen pressures. In this work, a refinement of the simulation procedure developed by the authors is presented. Particle breakup is computed from a Discrete Phase Model (DPM), with injection input data calculated from a Eulerian model. The new model is used to compare, for the first time, simulated and experimental results of three different materials (copper, tin and stainless steel 316L) produced with three different gases (nitrogen, argon and helium). Even for materials with such disparate melting points, the simulations predict quite accurately the median particle size for varying gas-to-metal mass flow rate ratios.

Innovative Aspect(s) :
Unlike most other publications, in this work rather than comparing simulated results with a single material, three different materials with low, medium and high melting points are compared: tin, copper and stainless steel. A new refinement of a previous model makes it more accurate and usable across materials with very disparate physico-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 : P-P38
ID : 6278293

Requested presentation type : Poster Presentation

Topic : Powders **Subtopic :** Powder Production

Author : Dr Pijuan Jordi (EURECAT Centre Tecnològic de Catalunya, Spain)

Co-author(s) : Mr Maicas Héctor (EURECAT Centre Tecnològic de Catalunya, Spain); Ms Cegarra Sasha (EURECAT Centre Tecnològic de Catalunya, Spain); Mr Hernández Ricardo (Jorcar Titanium, Spain); Dr Baldi Tomàs (GrupalArt, Spain); Mr Font Sergi (TMComas, Spain); Dr Nin Jaume (TMComas, Spain)

Title : Metal Powder Production From Machining Metal Scrap Using Centrifugal Atomization

Keyword(s) :
Powder Production, Centrifugal Atomization

Abstract :
In this study it is proposed to use machining metal chips with a pre-established and controlled chemical composition as raw material for metal powder production. The centrifugal atomization technology is used to produce this metal powder, bridging the gap between collecting recyclable metal scraps and obtaining the final powder, therefore enhancing the overall sustainability of the process. This study involves the collection of metal chips, their treatment for the removal of cooling liquids and other residues, and their subsequent use as raw material for metal powder manufacturing. Three different case studies are presented, including AlSi7Mg aluminum alloy, a Sn-based alloy also called White Metal alloy or Babbitt alloy, and a Ti6Al4V titanium alloy, illustrating the versatility and applicability of the proposed approach.

Innovative Aspect(s) :
Enhance the overall process to produce metal powders from machining metal chips.

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

POWDERS

OTHER POWDERS

EPMA

european powder metallurgy association

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

Paper Number : P39
ID : 6221751

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Other Powders

Author : Mr Manuel Manuel (Volkmann GmbH, Germany)

Co-author(s) :

Title : Industrialisation And Digitalisation In Additive Manufacturing

Keyword(s) :
Additive Manufacturing, Industrialization, Digitalisation, Powderhandling

Abstract :
The additive manufacturing of metal parts has developed rapidly over the last 10 years and opened up highly innovative areas of application. Initially used for small prototypes and small series, the technology has developed further and the components have become increasingly larger and more complex. Larger components require larger 3D printers and correspondingly larger quantities of powder, especially if not just one printer but several printers are operated in parallel. In additive manufacturing, however, the correct handling of the powder is just as important as the 3D printing process itself. Improper handling of the powder leads to a deterioration of the powder properties. Automated handling of the metal powder in the immediate vicinity of the printer has too often been neglected. It requires a highly automated and cost-efficient solution. Volkmann has addressed precisely this issue.

Innovative Aspect(s) :
Closed powder loop

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 : P40
ID : 6281535

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Other Powders

Author : Mrs Hansen Angelica (Höganäs AB, Sweden)

Co-author(s) : Mr Knutsson Per (Höganäs AB, Sweden); Mrs Ahlin Åsa (Höganäs AB, Sweden)

Title : Mix Concept Giving Excellent Fillability And High AD For Improved Compaction Performance

Keyword(s) :
Powder Mix, Lubricant, Productivity

Abstract :
High performance and low-cost component manufacturing often demands mix solutions with high apparent density (AD) and good fillability. Especially for taller and more geometrically complex components, powder solutions with higher AD and excellent die filling consistency are very important. Traditionally, metal stearate lubricants have been admixed to reach higher AD. Besides offering poor lubrication, residues of these lubricants accumulate in the sintering furnace, which requires regular maintenance stops. Höganäs' new bonded mix solution; Starmix Nova, is developed to offer high AD and excellent flow without using metal stearates. This study is based on both laboratory experiments and compaction trials in a production environment. Compared to a standard premix with amide wax, Starmix Nova mixes achieve 0.3 g|cm3 higher AD, which is equivalent of a premix with Zn-stearate and faster flow. In production trials, Starmix Nova proved excellent component weight consistency and improved productivity.

Innovative Aspect(s) :
New developed mix concept with metal stearate free lubricant giving high apparent density.This new mix concept enables high stability and productivity when producing P|M 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 : P41
ID : 6281542

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Other Powders

Author : Dr Cox Erik (Gencoa Ltd, United Kingdom)

Co-author(s) : Dr Cox Erik (Gencoa Ltd77, United Kingdom)

Title : Optimisation Of Degassing Metal Powders With Optical Emission Spectroscopy

Keyword(s) :
Degas, Process Monitoring, Powder Analysis, Vacuum

Abstract :
Although time consuming, degassing of HIP canisters is a critical step in the manufacture of powder hot isostatic pressed components. Carried out effectively, this stage of the process enables high quality components to be produced by preventing the retention of atmospheric contaminants such as oxygen, nitrogen, hydrogen and argon which are responsible for defects leading to poor material performance.Gencoa Optix is a gas sensing instrument that can be utilised to monitor the level of contaminant gases such as water vapour, nitrogen, oxygen etc. Optix requires no additional pumping or sampling equipment, And can operate throughout the entire degassing process.

Innovative Aspect(s) :
Use of a pioneering technique developed by Gencoa - Remote plasma optical emission spectroscopy, provides useful data allowing degas end point to be determined.

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 : P42
ID : 6282795

Requested presentation type : Oral Presentation

Topic : Powders **Subtopic :** Other Powders

Author : Prof Hong Soon-jik (Center for Advanced Materials and Parts of Powders (CAMP2), Kongju National University, Korea, Republic of)

Co-author(s) : Miss Kim In-Seo (Kongju National University, Korea, Republic of); Miss Go Eun-Ha (Kongju National University, Korea, Republic of); Mr JO Sung-Jae (Kongju National University, Korea, Republic of); Miss Lee Ye-Eun (Kongju National University, Korea, Republic of); Mr Baek Geon-Woo (Kongju National University, Korea, Republic of); Mr Kim Hyun-Joong (Kongju National University, Korea, Republic of); Prof Moon Jong-Un (Kongju National University, Korea, Republic of); Prof Lee Ji-Woon (Kongju National University, Korea, Republic of); Prof Song Gi-An (Kongju National University, Korea, Republic of)

Title : Characterization Of Recycled Powder And Effect On The Microstructure And Mechanical Properties Of Re-additively Manufactured 316L Stainless Steel Bulk By Directed Energy Deposition

Keyword(s) :
Additive Manufacturing, DED, 316L stainless steel, Recycling, Oxidation

Abstract :
The part manufacturing industry using additive manufacturing processes is increasing its focus on reusing post-process powders to improve cost competitiveness. However, the powder characteristics of AM-processed powders and their influences need to be addressed. Hence, in this study, we evaluate the powder characterization of the recycled 316L stainless steel powder using the Direct Energy Deposition (DED) process and further investigate its impact on 316L DED as-built samples. We studied the oxidation characteristics of the 316L stainless steel powders and compared the impact of powder recycling on the microstructural and mechanical properties of the as-built samples to those made from fresh powder. Our findings indicate that the use of recycled powders affects the microstructural and mechanical properties of the as-built samples. This was attributed to the presence of oxide-rich inclusions in the microstructure produced from recycled powders. The findings of the study indicate that the as-built sample produced using recycled powder.

Innovative Aspect(s) :
The characteristics of recycled powders in the DED process are based on their falling distance, an aspect not explored in previous research. This study revealed the presence of oxides in the microstructure of recycled DED 316L, which were absent in DED 316L produced using conventional origin powder. Additionally, we explored the oxide formation mechanism and its influence on the mechanical properties when using recycled powder in the DED process.

Reviewer's name : .....

Keynote ☐ Oral ☐ 1☐ 2☐ 3☐ 4☐

Poster ☐ Poster & Reserve Oral ☐

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