SUPREME

NEWSLETTER

September 2019 | Issue Four

Foreword by Coordinator

During the last four months, SUPREME partners have been very active. Our latest Executive Board meeting was organized on June 20th and we had an Extraordinary Steering Committee on July 4th. We are now actively preparing the T0+24 meeting which will be held at ASL in Sheffield this month.

In the last four months, several impressive results have been obtained: (i) the High Energy Ball Milling process developed at MBN for FeNiCuP powder allowed to increase the process yield by 27%; process productivity was increased by 20%, handling time reduced by 50% and energy consumption improved by 15%. The raw materials consumption was reduced between 18% and 36% depending on the element. (ii) the MIM process developed at TECNALIA for this alloy allowed to get a water debinding 3 times more effective than the reference commercial feedstock without any oxidation or cracking. (iii) the L-PBF process developed at GKN for a Hard Carbon Steel (0.35wt% Carbon) allowed to produce parts with density over 99%, showing elongation and hardness in agreement with CRF specifications without any case hardening surface treatment. (iv) IRIS has finalized the design and specifications of the monitoring systems to be installed at demonstrators' facilities. They also completed a series of experiments in the mining and iron ore processing facilities of LKAB in Kiruna (Sweden).

In this fourth edition of the SUPREME newsletter, CEA, leader of Workpackage 3 dedicated to Additive Manufacturing processes, and TECNALIA, leader of Workpackage 4 dedicated to Near Net Shape processes, inform you that several milestones have been passed, respectively, regarding L-PBF powders re-use, MIM process window optimization and MIM sprue re-use. IRIS, leader of Workpackage 6 dedicated to processes control, gives an update about sensors, software development and process monitoring. EPMA, in charge of dissemination activity, gives some news about the promotion of SUPREME results through recent exhibitions, orals at scientific conferences and training activity. Finally, the detailed presentation of the consortium continues with four more partners: PRISMADD, MBA, IDONIAL and TWI.

Enjoy your reading!

Dr Thierry Baffie
SUPREME project coordinator

Introduction

SUPREME aims at optimising powder metallurgy processes throughout the supply chain. It is focussed on a combination of fast growing industrial production routes and advanced ferrous and non-ferrous metals. By offering more integrated, flexible and sustainable processes for powders manufacturing and metallic parts fabrication, SUPREME enables the reduction of the raw material resources (minerals, metal powder, gas and water) losses while improving energy efficiency and thus carbon dioxide emissions, into sustainable processes and towards a circular economy. To achieve this goal an ambitious cross sectorial integration and optimisation has been designed between several powder metallurgy processes; gas and water atomisation as well as ball milling for metal powder production, laser based additive manufacturing and near-net shape technologies for end-parts fabrication. A consortium of 17 partners has been gathered on this purpose under the coordination of the Commissariat à L'Energie Atomique et aux Energies Alternatives (CEA), France. The Supreme Project kicked off on 21 September 2017 with a meeting taking place at Brussels.

The SUPREME Consortium

The SUPREME Consortium sees a mixture of organisations covering the full value chain from mineral to end parts applications: Atomising Systems Ltd (United Kingdom), CEA (France), Centro Ricerche Fiat (Italy), Dellas Srl (Italy), European Powder Metallurgy Association (Belgium), Fundación IDONIAL (Spain), GKN Sinter metals (Germany), Innovation Plasturgie Composites (France), IRIS (Spain), MBA Incorporado SL (Spain), MBNnanomaterialia (Italy), Outotec (Finland), Prismadd (France), Renishaw (United Kingdom), RHP Technology GmbH (Austria), Tecnalia Research and Innovation (Spain) and TWI Ltd (United Kingdom).

Promotion

EPMA have continued to advertise and promote the SUPREME project at several exhibitions including: Advanced Engineering 2019 (Gothenburg, Sweden, 27-28th March), Processing of Functional Materials Seminar (Bremen, Germany, 03-04th April), Develop3D Live (Sheffield, UK, 17th April), Metal Additive Manufacturing Seminar (Gothenburg, Sweden, 13-15th May), Engine Expo (Stuttgart, Germany, 21-23rd May), Metal Injection Moulding Seminar (Fischingen, Switzerland, 04-05th June), AP&M Frankfurt (Frankfurt, Germany, 5-6th June), Titanium world 2019 (Nantes, France, 10-14th June), Autonomous Vehicles Expo (Telford, UK, 27th June) and Powder Metallurgy Summer School (Trento, Italy, 15-19th July).

Figure 1: EPMA's Bruno Vicenzi at Engine Expo in Stuttgart, Germany

Figure 2: EPMA's Andrew Almond at Develop 3D Live in Sheffield, UK

The 2019 EPMA Powder Metallurgy Summer School took place in Trento, Italy, 15-19th July, and provided a comprehensive overview of all aspects of Powder Metallurgy to over 60 students from across Europe and with industry backgrounds. A short introduction to the SUPREME project was presented by B. Vicenzi (EPMA) during initial plenary session, and a module during the case studies afternoons named "SUPREME Project Workshop" was presented by Dr Iñigo Agote from Tecnalia and Ing. Marta Dai Pre from Dellas.

Figure 3: Ing. Marta Dai Pre (Dellas) giving her presentation at the PM Summer School in Trento, Italy

Promotion (continued)

A talk was given by Thierry Baffie (CEA-Liten) in front of 150 attendees at the Poudres 2019 Conference in Grenoble, France, 22-24 May 2019. This conference was organized by the “Powders and sintered materials” and "Additive Manufacturing" commissions of the French Society of Metallurgy and Materials.

Figure 4: Thierry Baffie (CEA Liten) presentation at Poudres conference.

Supreme Review Meetings

On June 20th, 2019, the SUPREME Project T0+21 Executive Board Meeting took place as a Skype conference, with all WP leaders attending. During the meeting all workpackages were reviewed, and the overall status of the project was analysed, leading to a list of subsequent actions for all partners.

Also, on July 4th an Extraordinary Steering Committee Meeting was held, also via Skype, in order to rearrange the budget among the partners and to cover new activities within the project. All amendments to the Grant Agreement were accepted with unanimous vote and the changes will hopefully be accepted by the EU in the next weeks.

The next meeting will be the T0+24 General Meeting, and is going to be held in Sheffield (UK), organised by the local partner Atomising Systems Limited, on 24th-25th September.

Demonstrator Update

Demonstrators monitoring and control system design (IRIS)

In WP6 of SUPREME project IRIS is working closely with end users to deliver process monitoring solutions that will enable them to optimize their processes against specific KPIs to improve energy and material efficiency. To achieve this IRIS will develop and install in end-user´s dedicated process monitoring systems comprised of both online sensors for real-time detection of key parameters and data acquisition software/hardware for seamless integration of the information with the end-users´ management systems.

In the past few months, IRIS has completed a series of experiments in the mining and iron ore processing facilities of LKAB in Kiruna (Sweden) where they tested the feasibility of monitoring the heat losses of the grinding units with IR cameras. Such grinding units are known to be notoriously inefficient with energy efficiencies typically below 20%. IRIS aimed at using the collected information to infer process energy efficiency, and eventually detecting correlations between heat losses and process parameters and generating a model for process optimization. The output of these trials was positive and will result in a publication.

In addition to this, IRIS has finalized the design and specifications of the monitoring systems to be installed in partners´ ASL, RENISHAW and GKN facilities in the following period.

Figure 5: Picture of LKAB grinding plant in Sweden

- In the case of ASL, several key process parameters of two gas atomizers will be monitored with the aim of comparing and improving the efficiency of metal powder production. To achieve this IRIS will install a set of power analyzers and industrial-grade scales and tap into ASL´s data management systems to collect and synchronize all relevant information from these and other (existing) sensors. This information will then be analyzed with the help of CEA to determine process efficiency under different production scenarios.

- In the case of GKN and RENISHAW, the goal is to determine and compare the efficiency of four different models of RENISHAW´s 3D printers, including three commercial and one prototype. IRIS is in charge of selecting and installing instrumentation such as gas mass flow meters and power analyzers which will be interconnected with a PC based platform, responsible for the data collection and processing. Gathering information coming from the new added instruments and combining them with data, already acquired directly from the 3D printers´ controllers, will play a significant role in the overall analysis. Similarly to ASL, the combined data will be processed with the assistance of CEA to determine process efficiency under several production scenarios.

Demonstrator Update (continued)

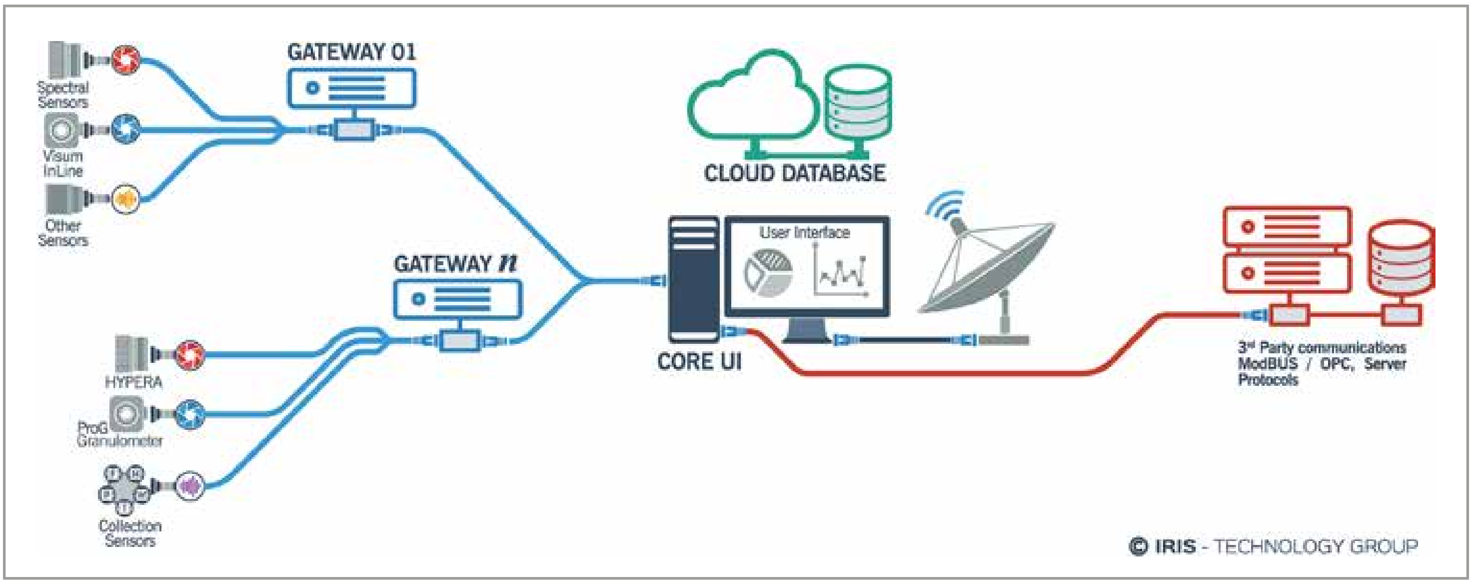

Figure 6: PatBOX System

Recycling study

WP3 Improvement of yield losses and energy efficiency in 3D metal printing (CEA Liten/PRISMADD)

WP3 objective is to increase the yield and the productivity of 3D manufacturing processes: laser metal deposition (LMD), plasma metal deposition (PMD), and laser powder bed fusion (L-PBF).

A large portion of the powder is not fused in a metal additive manufacturing production. Reusable quantities can easily reach around 60 to 80 vol.% in the case of L-PBF and are slightly less for LMD and PMD processes where 30 to 50 vol.% of the powder can be collected after printing.

One of the main advantages of these processes is the possibility of theoretically reusing all the non-fused powder. To take up this challenge and thereby reduce raw material consumption is a prerequisite for the improvement of the process, but in doing so, it must obviously be ensured that the quality of the produced parts remains stable.

Traditionally unused powder is sieved and virgin powder is used for making up the amount necessary for the next printing run. However, the physical changes of the powder (chemical composition, particle size distribution, apparent density, optical properties, etc.) after several cycles of recycling are not well known, quantified and controlled at the moment. Up to now, a few studies have been carried out, and so only on Ti-6Al-4V, CoCr, stainless steel or IN718. The impact on the bulk characteristics is not known either.

One of the tasks of the SUPREME project is to characterize and evaluate the quality evolution of three iron-based alloys (316L, 17-4PH and L40) and one non-ferrous alloy (Inconel 625) after cycles of reuses. The study, which involves several partners of the consortium (PRISMADD, IDONIAL, IPC, TWI and CEA), will offer the opportunity to cross different equipment, practices and powders. Productivity gains will be quantified in terms of raw materials and energy savings.

Rules for the study

In order to be able to compare the results, the partners agreed on the following rules for the reuse study:

(i) no addition of fresh powder is done,
(ii) all the volume of powder is transferred at each cycle from the feeding system to the building plate,
(iii) the same weight of powder is consumed at each cycle,
(iv) the design of the produced parts must generate a high surface/volume ratio

Main results from L-PBF studies (PRISMADD-IN625 and CEA-316L)

One of the rules is to produce parts with high surface/volume ratio, to enhance the contact between the unfused powders and the consolidated parts. Slim cylinders or lattice structures were used to respond to the request (Figure 7).

Recycling study (continued)

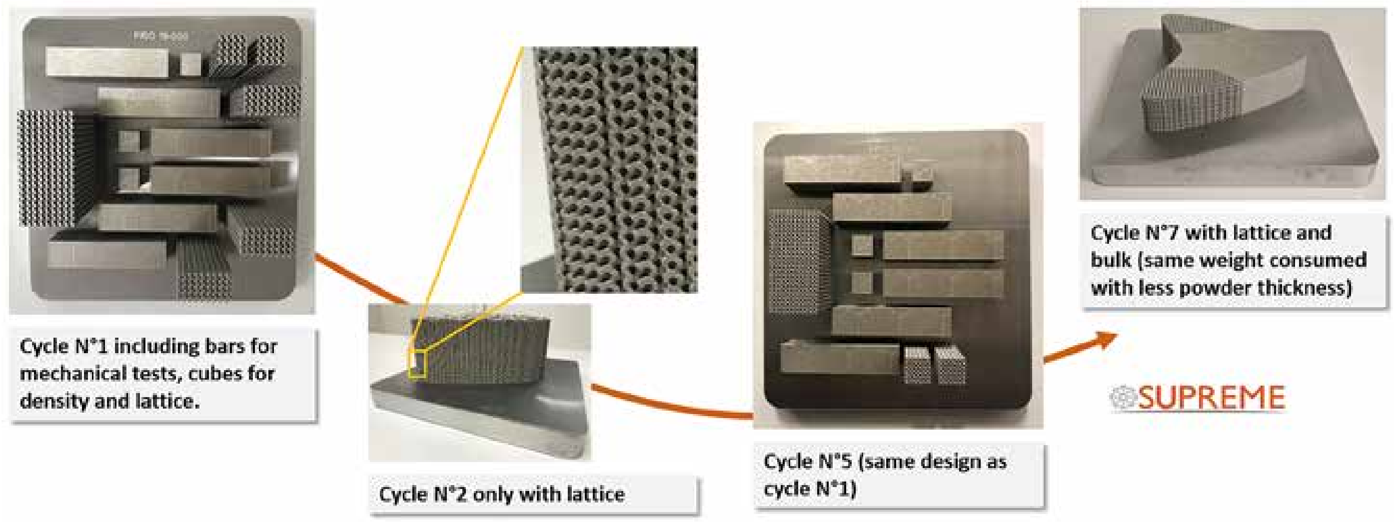

Figure 7: examples of a reuse study on 316L @ CEA (SUPREME)

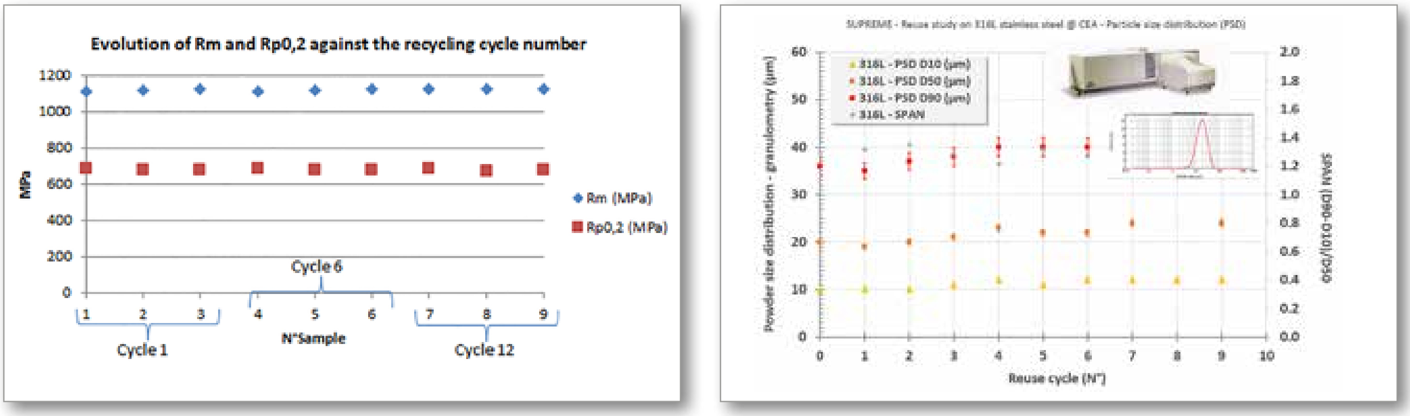

Figure 8: examples of characterizations performed during the reuse studies ; (a) tensile tests on IN625 @PRISMADD and (b) PSD analysis on 316L @ CEA (SUPREME)

In the next few months, the same type of study will be conducted at IDIONAL (316L, 17-4PH), TWI (IN625) and IPC (L40 steel) to complete these conclusions.

News from WP4

Near Net Shape Powder Metallurgy Hot Isostatic Pressing (NNS PM HIP) Manufacturing Route to Manufacture High Value Engineering Parts (TWI)

HIP being a solid state process is known to be an efficient and viable technique for the manufacturing of high value complexed shape components. NNS PM HIP is an advanced manufacturing technology which can have both shape complexity of castings and the properties of thermomechanically processed wrought material. It is used to create near net-shape components using pre-alloyed atomised powder, which is loaded in sacrificial canister up to its packing density and consolidated within a HIP vessel. The process has the potential to vastly improve the 'buy-to-fly' ratio of large aerospace components, when compared to a conventional casting-forging and machining manufacturing route.

During the last decade, NNS PM HIP was developed and used for aerospace parts to replace the traditional manufacturing processes. This advance manufacturing technology also found numerous commercial applications in space, oil and gas, nuclear, power generation industries especially for the manufacturing of large size critically loaded components. This technology is quite useful for the manufacturing of medium to large sized high value complex parts.

Figure 9: 3_4_Y Submarine Pipe

TWI within SUPREME project is aiming to develop and validate a cost-effective NNS PM HIP manufacturing route for Inconel 625 components for sub-marine application. This work will establish the HIP processing window for Inconel 625 powder and explore new low cost canister manufacturing methods development. The effect of atomisation type (water, argon gas, nitrogen gas and plasma atomised) and narrow and wide powder particle size ranges (Figure 10) on microstructure and mechanical properties of the HIPed material (Figure 11) will also be assessed. Thus, using optimised process parameters, small scale representative geometrical component (Figure 9) will be produced and assessed to see if they meet the OEM requirements in terms of accuracy, integrity and mechanical properties.

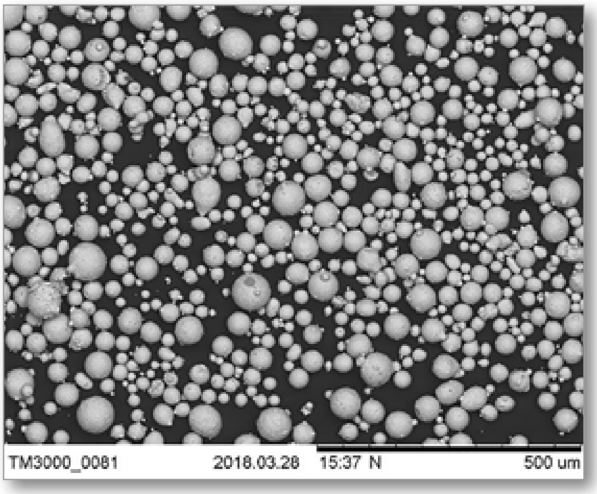

Figure 10: SEM image of nitrogen gas atomised (NGA) Inconel 625 powder (15-150µm)

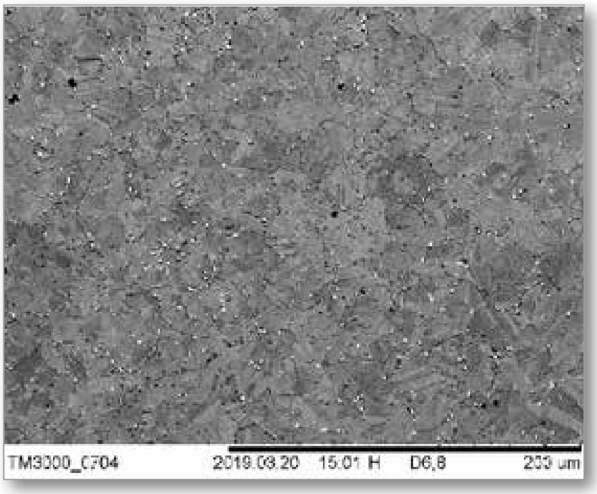

Figure 11: SEM micrograph of HIPed NGA Inconel 625 (15-150µm)

WP4 Improvement of yield and energy efficiency in near net shape manufacturing (Tecnalia)

WP4 objective is to improve near-net shape processes (HIP and MIM) in order to reduce material scrap and energy consumption. Although these net-shape processes are very efficient in terms of material usage compared to conventional machining (or casting), strong improvements could be made. By increasing HIP and MIM processes performances (complex shape, quality, and available materials), the SUPREME project will allow to replace more conventional parts than today, saving a lot of raw material and energy usage.

During the last months the following main goals have been achieved:

MIM process for Medical applications (CEA and IDONIAL):
metal injection moulding process for two different medical applications is being developed: a medical tool (Glenoid Reamer) made in 17-4H material and an implant (Dynamic Hip Screws, DHS) made in 316L.

During these months milestone MS11 has been achieved (MIM processes optimised: processing window optimised). This includes the development of new feedstocks using both SUPREME binder and commercial binders. Water atomised powders developed by a SUPREME partner have also been used for MIM process. All these developments are allowing to reduce the energy consumption and manufacturing cost. For example a substantial increase in the binder removal amount during the water debinding step compared to commercial binder systems is allowing to decrease the time and energy consumption during the thermal debinding step. The fact of using water atomised powder instead of gas atomised powder also reduces the final cost of the part.

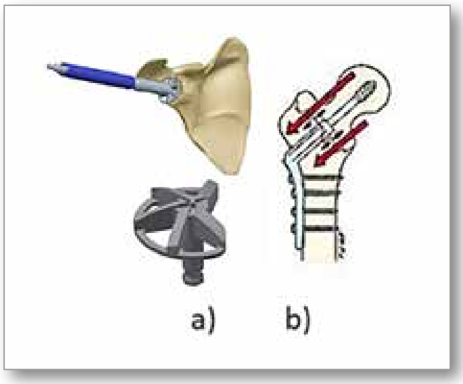

Figure 12:
a) Glenoid Ream b) Dynamic Hip Screw (DHS)

It has also been proved that the use of reused injected material (sprues and runners) is possible. The obtained properties using this reused feedstock are comparable to the virgin feedstock.

During the next months re-utilization of L-FPB powder for MIM feedstock production will be studied.

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Development of PIM process for Diamond composites for tooling application (TECNALIA, DELLAS):

Diamond injection moulding of diamond composites to produce segments of a diamond gang saw blade.

During these months milestone MS13 has been achieved (FeNiCuP composite feedstock available). The achievement of this milestone includes the substitution of Co (conventional metallic phase used in diamond composites) by a cheaper and less toxic alloy. In addition, it has been proved the possibility to use High Energy Ball Milled powders for injection moulding process (beside the typical gas atomised powders). Feedstocks for injection moulding process have been successfully developed (using a novel water based binder developed in SUPREME project). This binder system allows a more efficient water debinding step (extracting three times more binder than with commercial water soluble binders). This fact allows a more efficient thermal debinding process and a substantial manufacturing time reduction. The first segments have been already injected using this feedstock.

Figure 13: Segments of a Gang Saw Blade

Figure 14: Injected Segments

HIP process for Marnie applications (TWI):

TWI is using HIP process to produce nickel based (IN625) parts for submarine application. The main objective is to minimise the BTF (Buy-to-Fly ratio), it is said the raw materials used versus the final part mass; thus increasing the process yield in what raw materials consumption is concerned.

During this months, different Inconel 625 powders have been tested: water atomised powders (WA), nitrogen gas atomised powders, (NGA), Argon gas atomised powders (AGA) and plasma atomised powders (PA). The morphology as well as the chemical composition of these powders have shown very different behaviour during HIP process and different final microstructures. PA and AGA powders seem to be the most promising powder for HIP process. WA and NGA powder showed lower mechanical properties and interstitials in the final microstructures which lead to a lower performance of the final part.

During the next months the optimisation of the HIP process will be carried out using PA and AGA powders. A full characterisation for the HIP-ed parts will be included: microstructure, microhardness, Tensile and Impact tests.

Figure 15: Submarine Structural Part

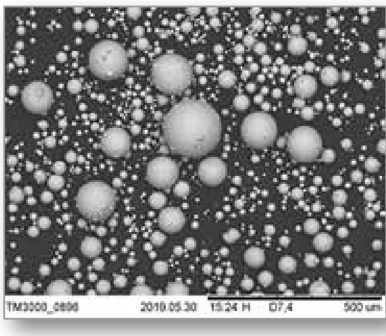

Figure 16: IN625 Plasma Atomised Powder

Meet the partners

TWI

TWI, formed in 1946, is a world-leading not-for-profit research and technology organisation (www.twi-global.com) with a turnover in 2014 of £80m(€94million). From bases in the UK, South East Asia, India, the Middle East, Central Asia and the USA, over 900 staff provide expertise in joining and fabrication, material science and structural integrity and has representation on over 100 standards committees. Services include generic research; contract R&D; technical information; engineering services and advice; standards development; and training and qualification services.

TWI is internationally renowned for its ability to employ multidisciplinary, impartial teams to implement both established and advanced joining technologies, or to solve problems arising at any stage of the product life cycle. TWI is a membership-based organisation with 1,800 Industrial Member companies from 70 countries, representing every sector (aerospace, automotive, engineering and fabrication, equipment consumables and materials, electronics and sensors, medical, oil and gas, power) of the manufacturing industry.

Summary of R&D investment in Additive Manufacturing (AM)

Over the last five years, TWI has participated in AM research & development activity totalling over £63m, funded from UK and EU public funding bodies, joint industry projects and confidential member company projects. TWI has been advancing AM technology for more than 20 years, delivering innovative solutions to clients spanning multiple industry sectors and technologies. Our comprehensive AM service offering has the ability to add value at all stages of the technology readiness level (TRL) process through concept and business model generation, technology and system development, demonstration, product evaluation and validation.

In the past 18 months, TWI has secured more than £6m of direct project income relating to AM technology. Our current commitment includes in excess of 25 AM collaborative projects, as well as confidential single client work for our Members. We have over 35 dedicated staff with combined expertise covering a comprehensive range of AM services encompassing processing technologies, automation and manufacturing systems, simulation and design, post thermal treatments, materials characterisation and destructive and non-destructive evaluation.

We also host an annual industrially focused AM seminar showcasing the latest developments and provide input to standards and committees from organisations including Nadcap, ASME, ASTM and the UK and EC Strategy for AM.

Innovation

TWI has a rich and well publicised history of innovation and invention dating back to the time of the British Welding Research Association in the 1940s. Memorable highlights from the past include the CTOD method for measuring fracture toughness, the Wells wide plate test, types of high powered CO_2 laser, and many innovations in the use of laser, friction, arc, adhesive bonding and other technologies related to welding, joining, coating and testing. Current inventions being actively exploited at TWI include Friction Stir Welding (FSW a revolutionary solid state), SurfiSculpt (a power beam material modification technique), Vitolane (a unique platform technology for the creation of bespoke materials) and novel methods for welding using reduced pressure High Power Electron Beam (HPEB) technologies. TWI is actively exploiting 5 distinct inventions and has over 180 granted patents in its portfolio. TWI has granted over 250 licences worldwide. Income from licensing exceeded £1.94m in 2014.

Hot Isostatic Pressing (HIP) and Laser Metal Deposition (LMD) Process Development and Services

TWI has a diverse range of industrially relevant facilities such as HIP and LMD which are directly relevant to the SUPREME project. TWI also has extensive sample characterisation facilities (metallographic laboratory, scanning electron microscopy, light microscopy, chemical analysis) etc. and mechanical testing (fatigue, crack growth, tensile, fracture, etc.) in order to assess performance. In 2015, TWI opened three new laboratories at its Cambridge headquarters, including state of the art facilities for the National Structural Integrity Research Centre (NSIRC), a dedicated postgraduate centre for industry led engineering research TWI also houses a professional institution, The Welding Institute with a separate membership of 6000 individuals. TWI has offices in Europe, North and South America, India and Far East, and thus offers global connections to its customers. TWI currently operates from 54,000 square metres (581,000 square feet) of manufacturing, testing and training space; five UK and 13 overseas facilities serve both its Industrial Membership and its training and examination needs.

Hot Isostatic Pressing (HIP)

TWI has in-depth knowledge in HIP technology which is extensively used to make near net shape powder metallurgy (NNS PM) complex shaped components, densify castings, diffusion bonding and post thermal processing of AM parts for various industrial sectors. A low cost sacrificial canister manufacturing technique was developed to produce NNS PM HIP high value parts. Moreover, TWI state-of-the-art powder characterisation facilities are also playing a vital role during the initial assessment of feedstock powders used for advanced manufacturing processes.

Meet the partners (continued)

Laser Metal Deposition (LMD)

TWI has developed a world leading capability and proprietary software (ToolCLAD™ CAM software) to manufacture thin walled 3D geometries using LMD (Figure 17). The approach adopts a multiple axis deposition strategy which includes guided manipulation of the LMD nozzle in Cartesian space (xyz) relative to the surface of a continuously rotating and tilting build substrate. With precise synchronisation of the movements of rotation and tilt of the substrate with incremental movements of the coaxial nozzle, a continuous spiralling track weld can be deposited. This helical multi-layering technique allows a thin cross-section wall contour to form which is representative of the intended CAD geometry. By manipulating the substrate, and minimising the movement of the LMD nozzle, unsupported overhanging features can be generated with a consistent high surface quality (in range 12-20 microns has been achieved with nickel alloys). The technique uses a coaxial LMD nozzle and has been used to manufacture pressure vessels and casings for gas turbines. However, productivity remains low (0.1-0.3 kg/h), thus SUPREME project will look to develop procedures to manufacture similar geometries by using a modified LMD process.

Figure 17: LMD of civil aero engine part

PRISMADD

PRISMADD is a French company, created in 2014, specialized in the production of parts by metal and plastic Additive Manufacturing (AM). The company proposes an offer for technical industrial sectors such as defense, aeronautics, automotive, medical or nuclear. PRISMADD has made a name for itself through a vertical integration over the whole value chain: from materials to design, production, post-treatments, control and distribution. It allows PRISMADD to produce functional parts reaching high customers' expectations in terms of performance and repeatability.

PRISMADD counts today 30 employees, 11 AM metal machines (technology: SLM; materials: TA6V, AlSi7g, 316L, 17-4PH, IN718) and 3 AM plastic machines (technologies : FDM, SLS, MJM ; materials : PC, ABS, ULTEM 9085 & 1010, Duraform, Peek, PA12). This global machine park is spread over several locations: 3 in France (Montauban, Saint-Etienne, Saint-André des eaux) and 2 overseas (Japan and Singapore).

In 2016, to solidify its industrialization and expansion, PRISMADD joined the Additive Business Unit of the group WEARE. We Are Group is the story of a group of family-owned SMEs that built their success based on their customer focus, development of technical skills, and passion for technology and aviation. The group synergy allowed WEARE to stay tier 1 supplier with big companies notably in the aeronautics, medical and defense sectors. WEARE ensures its high performances by constantly innovating in its core business technologies: turning, milling, subassembly, materials and AM. Today WEARE counts 2000 employees, 275 M€ turnover and has 31 sites worldwide.

MBA SURGICAL EMPOWERMENT

MBA SURGICAL EMPOWERMENT is a leading Spanish company in the medical surgical technology distribution sector in the Spanish, Portuguese and Italian markets. Its main objective is to make available the most innovative and complete solutions to medical professionals in the neurosurgery, orthopaedics and traumatology fields, trough the MBA brand, as well as in the anaesthetic and surgery markets through BIOSER, its specialized division.

With 30 years of experience in the surgical and health sector, the pillars of its activities are: investment in state-of-the-art technologies, unrivalled customer service, training and commitment to scientific development.

MBA SURGICAL EMPOWERMENT works with the top manufacturers and from its beginning it has developed two extensive commercial networks which are able to bring solutions and services to the most demanding healthcare specialists.

MBA product range includes:

- Knee implants
- Hip implants
- Shoulder implants
- Other joint implants
- Large reconstruction system
- Trauma
- Devices for spine surgery
- Biologicals
- Surgical support and accessories

BIOSER product range includes:

- Anaesthesia
- Surgery
- Biologicals

MBA SURGICAL EMPOWERMENT channels all the scientific knowledge generated by the company through the MBA INSTITUTE, an area that supports applied clinical research through collaboration with surgeons, universities and scientific entities.

Meet the partners (continued)

Our figures:

- 700 hospital clients
- 260 employees
- 60 M€ Consolidated turnover
- 27000 surgeries per year

Our history:

- MBA starts up in Asturias in 1988, marking a turning point in the understanding of traumatology and orthopaedics.
- In 1989 MBA began expansion across Spain: Madrid, Barcelona, Valencia and in 1999 international development begins, taking the first step in Portugal.
- In 2000 total coverage is achieved in the Iberian Peninsula.
- From our experience in Portugal we opened offices in Italy in 2002.
- N+1, now Alantra, a leading global investment bank, acquires the majority of MBA's share capital in 2008.
- In 2012 MBA moves to its new headquarters, Silos del Intra, awarded best National Civil Engineering Project 2013.
- In 2017 The brand is updated and MBA SURGICAL EMPOWERMENT is born. MBA and BIOSER will operate under this global brand.

For further information on the SUPREME project please contact Sabine Hazoumé at EPMA on **sh@epma.com** or the project leader Dr Thierry Baffie at CEA at **thierry.baffie@cea.fr** or visit the website at **www.supreme-project.com**

This project has received funding from the European Union Horizon 2020 Programme (H2020) under grant agreement no. 78612