Issue 5 | 2022/Q3

AM CHRONICLE

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FEATURE ARTICLE

METAL AM INDUSTRY CONVERGED AT THE REGIONS FIRST METAL AM FORUM

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EDITORIAL

Unlocking the Potential of Additive Manufacturing

Recently at an America Makes event, Terry Wohlers, a renowned global AM consultant shared insightful information that Additive Manufacturing represents a mere 0.1 % of the total manufacturing business landscape of $ 14.3 Trillion.

The Additive Manufacturing industry needs to see this statement with a lens of opportunity and see how all the stakeholders can work together to increase the pie and how AM can make a larger impact. There is a lot of work which needs to be done to make this technology more acceptable in the eyes of the conventional manufacturing industry in the areas of certification to boost confidence, material development, reducing cost of the entire process, reliability in production and many more. At AM Chronicle our aim is to provide a conducive platform for the industry to communicate their efforts in this direction and make an honest effort to provide the necessary support system.

Our feature article in this issue mentions he launch of the regions first Application focused Metal Additive Manufacturing symposium focused on industry, academia and government. The issue also covers topics ranging from Polymer Additive Manufacturing, Aerospace Case Studies, Metal Additive Manufacturing Landscape, Growth of AM in UAE, AM Startup series powered by AM Ventures and more.

Our attention is now keenly focused on AMTech which will be hosted on 2-3 December 2022 at the Hitex Exhibition Centre in Hyderabad which will see the entire ecosystem of Additive Manufacturing in the region converge at one location to network, exchange ideas and shape their business. The tradeshow will also feature technical sessions focused on applications and a dedicated healthcare zone. ASTM in partnership with AM Chronicle will also be organizing the first ASTM Workshop in India preceding AMTech. AMTech will also be featuring a Startup Zone and a Startup Pitching Event in close collaboration with AM Ventures and ASTM.

We are always at the forefront with our efforts and will play our part in unlocking the true potential of Additive Manufacturing.

Aditya Chandavarkar
Co-Founder - AM Chronicle

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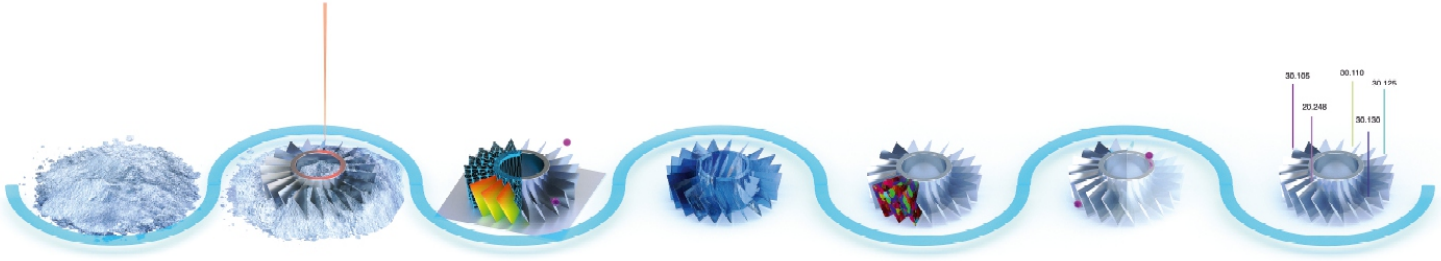

1	2	3	4	5	6	7
Powder and Material Characterization	In-Process Metrology and Data Analysis	Post-Print Heat Treatment and Part Removal	Defect and Inner Structure Inspection	Post-Print Material Quality Inspection	Dimensional and Surface Quality Inspection	Process Data Statistics and Analytics
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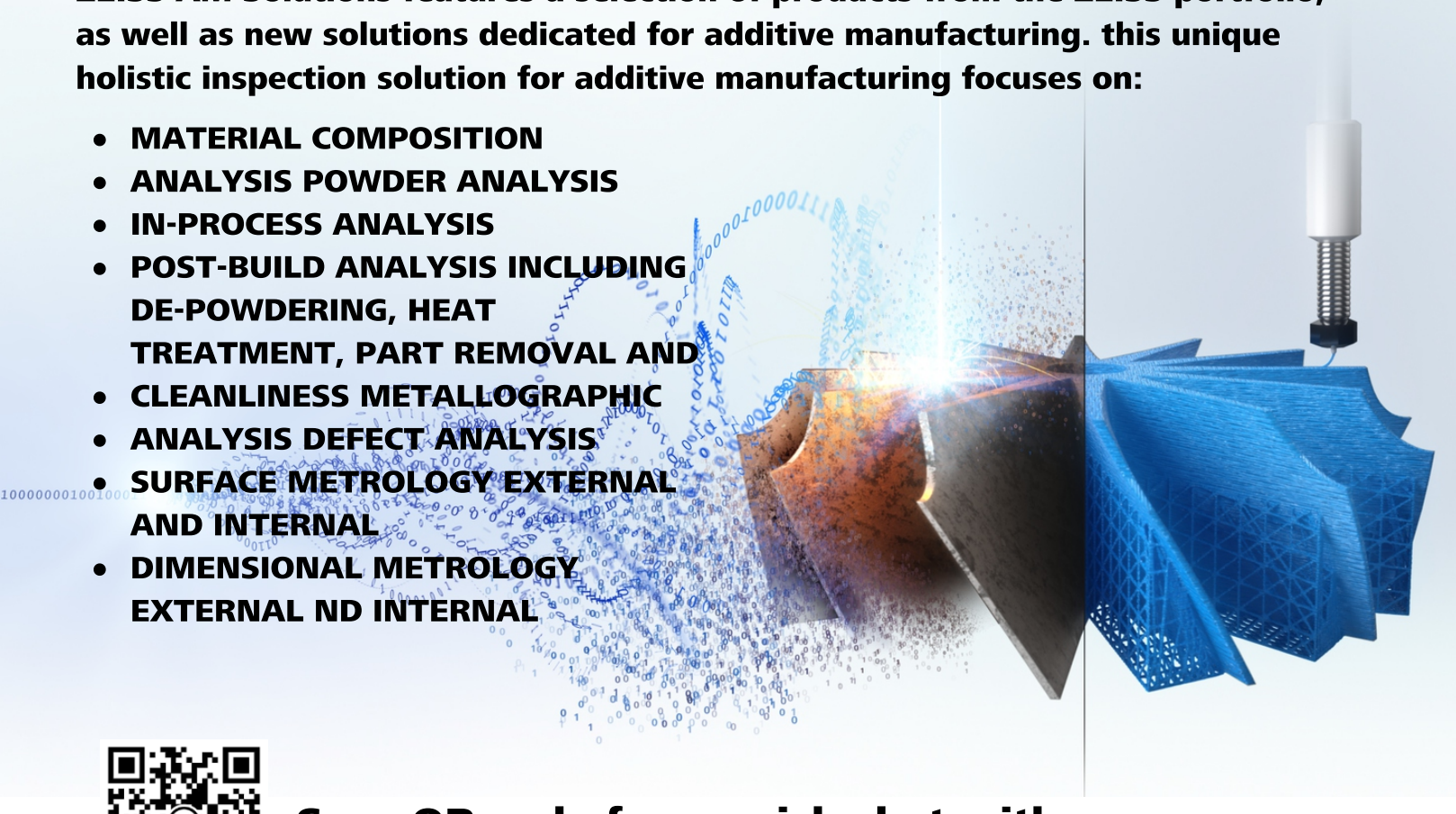

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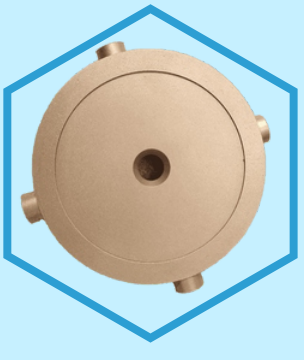

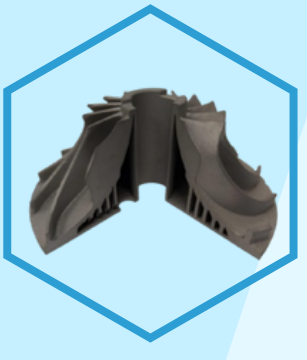

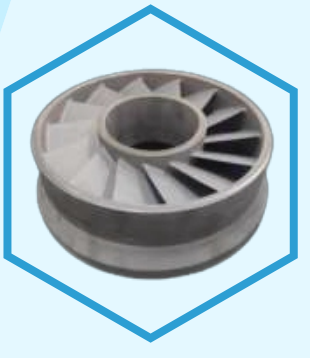

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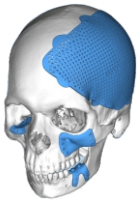

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AM Chronicle is the Leading 3D Printing Voice of the Region focused on India, APAC, Middleeast and Africa working with the industry to advance adoption of Additive Manufacturing.

Our service offering consists of an online knowledge sharing portal, Quarterly Magazine, weekly newsletter and social media activation.

CONTENTS

Metal Additive Manufacturing Industry Converged at the regions first Metal AM forum

AM Chronicle successfully organises the regions first Metal Additive Manufacturing Symposium to Advance the Indian Metal Additive Manufacturing Ecosystem in India.

The regions first Metal Additive Manufacturing symposium organised by AM Chronicle saw active participation from 45+ speakers and 230+ delegates across the metal additive manufacturing ecosystem including users, government establishments, academia and industry stakeholders. The event was inaugurated by Shri APVS Prasad, Chief Executive, CEMILAC and Air Vice Marshal PS Sarin VSM, ACAS(MP), Indian Air Force, reinforcing the government interest in adopting Additive Manufacturing for relevant applications in India.

Post the inaugural address, the event tone was set with a industry roundtable sessions focussed on on setting the roadmap for Scaling Metal Additive Manufacturing in India which had a good mix of experts from

government, policy making bodies, service bureaus, technology providers and large MNCs bring different persectives to the table. Representatives from the Indian Air Force also shared their problem statement and the areas where they are looking to adopt Additive manufacturing.

MAMS 2022 saw Key Note Presentations from Dr Kishora Shetty, Engineering Lead, Boeing; Mr Jaspreet Sidhu, CEO, NCAM; Michel Pereme, Director – Global Channel Business – Simufact, Hexagon; Dr V Anil Kumar, Scientist SG, VSSC – ISRO and Mr Shripadraj Ponkshe, General Manager – Material Engineering, Tata Motors bringing to the fore different perspectives of Metal AM including Policy, Aviation, Space, Global Insights and Automotive.

The 2 days high quality structured program was divided into 5 sessions which included plenary talks and panel discussions to touch upon the various aspects of Metal AM in India.

The first technical session was focused on Standards, Certification, and Qualification. This session featured insightful presentations from ASTM International, CEMILAC, Wipro 3D and Zeiss. The session concluded with a panel discussion on - Standards and Certification as enablers of Metal Additive Manufacturing. The session helped to understand the critical role of standards and certification in the process of product development using metal AM. It also focused on how the metal AM companies can obtain certification to supply their products to aerospace and defense industries. Furthermore, the speakers also highlighted the recent growth in standards and certification aimed for the metal AM sector.

The second technical session focused on Modeling Simulation and DfAM. This sessions featured talks from Honeywell Aerospace, Baker Hughes and GTRE. The panel for this session discussed the various strategies to get it First Time Right with Metal Additive Manufacturing technical talks were further followed by a panel discussion on the metal AM ecosystem. This session helped to understand the critical role played by these processes to achieve a better outcome.

Materials have an essential role in the performance reliability of the metal AM parts, and new materials are developing rapidly. Consequently, the third technical session focused on materials for metal AM to discuss the latest development in materials. Speakers from M4P and Pratt and Whitney delivered the technical talks in thi session The talks were followed by a panel discussion on the Future of Metal AM materials. The session helped to understand the technical challenges in the process of new materials development for metal AM and developing application-specific materials can cater the requirements of a wide range of industries.

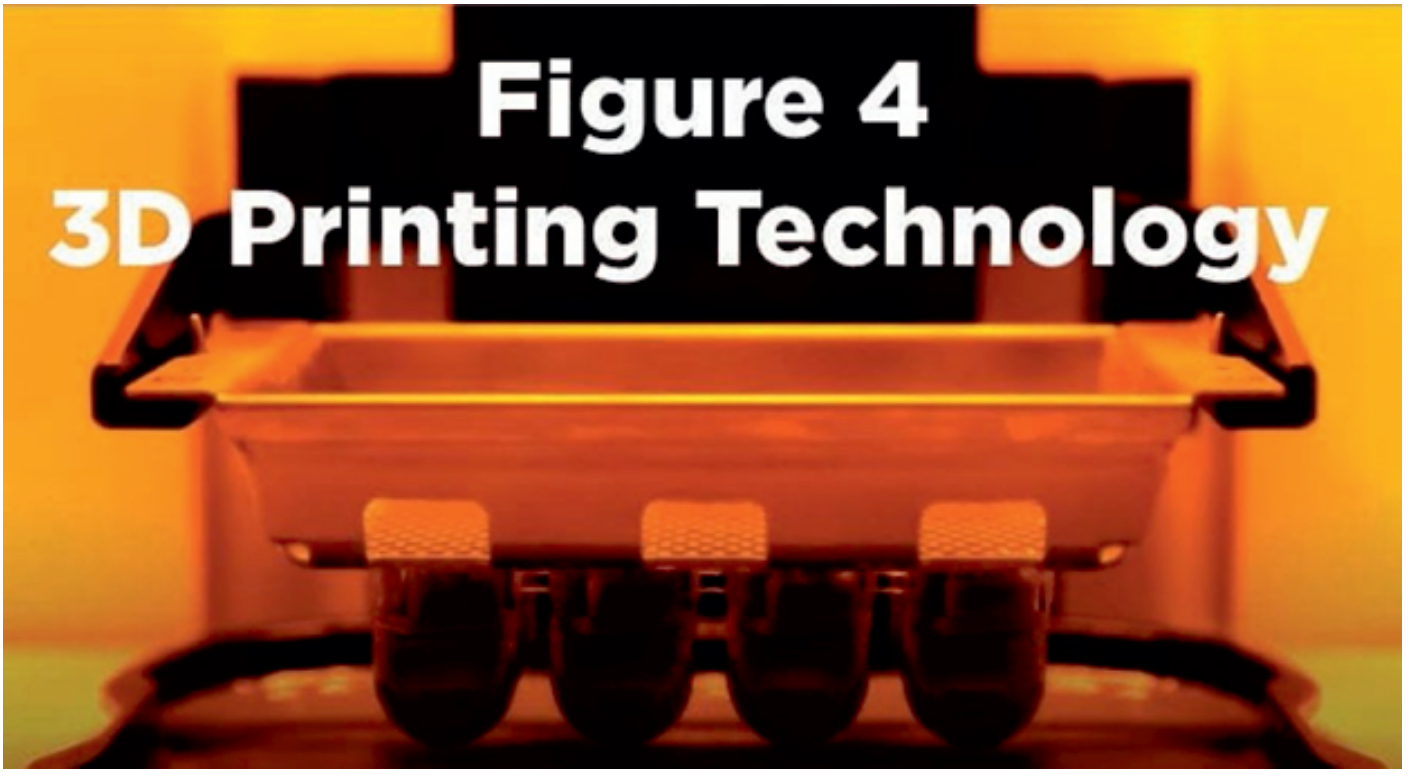
The fourth and fifth technical sessions focused on AM process, technology, and applications and included speakers from Agnikul, Baker Hughes, Objectify, Collins Aerospace, Imaginarium, GE Healthcare, Supercraft3D and IISc Bengaluru. The talks ranged from use cases of Metal Additive Manufacturing in space, aviation, energy, supply chain optimization, medical devices and patient specific implants. Session four also featured a panel discussion on driving the demand for metal AM in the industry.

The event concluded on a positive note with the announcement of a Metal AM Industry workgroup which will work together to address common challenges in the industry to see how the potential of this technology can be unlocked in the country with the indigenous expertise. The Metal Additive Manufacturing Symposium in its first edition has established a credible platform for industry, academia and government establishments to network, interact and develop the ecosystem further

How is the Figure 4 3D Printing Technology changing the production capabilities of the manufacturing industry?

Shree Rapid Technologies

Figure 4 has proved itself to be a productive and cost-effective digital manufacturing solution. The article discusses about the Figure 4 technology in detail



3D printing has been in the limelight for a few years and is now set to revolutionise the production process for manufacturers. Today multiple manufacturers are increasingly adopting 3D Printing to improve their output, design and speed of production. Whether it is Healthcare, Automobile, Defence, Jewellery or any other industry 3D Printing has started to become an integral part of their manufacturing workflow.

With the improvement in technology and the continuous innovations, 3D Printers are now able to print end use parts of various sizes with the highest

level of accuracy. One such technology that has catapulted 3D Printing into the production of end use plastic parts is the 3D Systems Figure 4 Technology.

Figure 4 has proved itself to be a productive and cost-effective digital manufacturing solution. Delivering parts with Injection Moulded like quality for a wide range of applications, Figure 4 is a tool less alternative to traditional manufacturing processes. Offering a large range of innovative materials, it's a technology that is being adopted across industries.

The Figure 4 Technology with its multiple variants have expanded the use of 3D Printers across industries. For Jewellery pattern 3D Printing it offers the Figure 4 Jewellery, for low volume production the technology offers the Figure 4 Standalone which can be later scaled up using the Figure 4 Modular and the production variants of the Figure 4 Technology.

The breakeven point where 3D Printing becomes more cost effective versus the traditional manufacturing can range from 100 to 10,000 parts, which the Figure 4 Technology can deliver within few minutes to a months' time, depending on the industry material and application. To understand the technology further let's take a look at how the Figure 4 Technology is changing the production capabilities of the manufacturing industry.

The introduction of the Figure 4 non-contact membrane based Digital Light Processing (DLP) technology led to multiple transformations in the vital manufacturing and 3D Printing areas. Such as:

1. Prototyping

The Digital Light Processing (DLP) technology offered by the Figure 4 transformed the materials, speed and functionality with which prototypes could be efficiently produced. With print speeds of upto 100mm/hr in Z axis with some materials Figure 4 enabled a time to first print in hand within few minutes. Giving the user the advantage of same day prototyping with injection moulded like part quality.

2. Direct Digital Small Series Batch Production

Figure 4 has become an alternative traditional injection moulding that has enabled designs to go straight from CAD to manufacturing without tooling of delay. Helping manufacturers produce upto 10,000 parts depending on the part size using the Figure 4 Modular variant within a few days. Thus, also improving the time to market and reducing the total cost of operations.

3. Just in Time Manufacturing

Features like fastest throughput, high accuracy, tool less production. The advantage of a smooth surface finish due to the non-contact membrane along with the advantage of mobility make the Figure 4 ideal for Just In Time Manufacturing of end use parts. The compact nature of the machine allows it to be used in any corner of the office, without the need of any special site conditions.

Advantages of Figure 4 Technology

From the launch Figure 4 Technology has delivered huge advantages over traditional manufacturing in multiple scenarios, giving life to multiple ideas & designs benefiting manufacturers in many ways. Here

are some of them:

1. Better Quality, Faster Time to Market & Lower Cost

Figure 4 technology with its non contact membrane delivers smoother and sharper finished parts. The tool less production of parts along with automated job management and queuing, automated material delivery and centralized post-processing help in faster delivery of the part thus reducing the time to market and cost.

2. Wide range of Materials

With over 30 years of proven R&D experience and process development expertise, the 3D Systems team has made a wide range of materials available for the Figure 4 Technology. Addressing a wide variety of applications needs, for functional prototyping, direct production of end use parts, moulding and casting, Figure 4 delivers highly accurate injection moulded like part quality with six sigma repeatability. With materials such as: Rigid Materials, Elastomeric Materials, High Temperature Material and Specialty Materials.

3. Mobility

The Figure 4 Technology offers a very compact design that allows it to be installed in any office space with minimum infrastructure changes. The plug and play operation of the technology helps it to be operated in any location without much difficulty. In comparison to traditional manufacturing processes a Figure 4 3D Printer offers a speedy manufacturing of parts in places where part production was otherwise unavailable. Thus, encouraging Just In Time Manufacturing.

4. Reduced Waste

Traditional manufacturing processes used a large amount of space and energy to store raw materials and finished products. With the introduction of 3D Printing the requirement of such space has become negligible with the material being stored in bottles in case of resins & powder materials and producing parts only when required in the quantity required. This in turn has reduced the amount of waste caused due to storage, part manufacturing and logistics.

Wide Range Of Applications

The Figure 4 Technology with its versatility and range of materials it can be used for a wide range of applications such as rapid iteration, functional prototyping, design verification, end-use parts for low volume production and replacement parts, digital texturing applications, jewelry casting patterns, rapid tooling of molds, master patterns, jigs and fixtures.

The Future of Figure 4 Technology In The Manufacturing Industry

In the near future we are looking at Figure 4 Technology replacing the injection moulding process in many of the applications and producing final end use parts, shortening the time to market further and benefiting manufacturers and end users. With the growing demand of 3D Printers and the superior technology of Figure 4 3D Printers the roll of 3D Printing will see a sharp increase in the manufacturing industry, since this technology produces better output in terms of design, finish, accuracy and speed with greater flexibility in customising products along with the comfort of producing any intricate or complicated design with the six sigma repeatability, by lowering costs and overhead expenses.

ABOUT THE AUTHOR

Shree Rapid Technologies

Pioneers in supplying 3D Printing and 3D Scanning Technologies from global brands like 3D Systems, ZEISS, Formlabs, 3D Ceram, BCN3D, BMF, GOM and many more. SRT is a 15 year old company with multiple decades of experience in providing additive manufacturing solutions helping organizations grow and develop their digital manufacturing workflows.

Overview of the AM Forward Initiative Launched By President Biden

Chinmay Saraf

Governments across the world are developing policies for the growth and development of the additive manufacturing ecosystem. "AM Forward" is an initiative taken by President Biden to develop AM ecosystem in the United States.

The governments of various countries have recognized the role of additive manufacturing (AM) in fostering economic development. To develop the AM infrastructure in the USA, on May 06, 2022, President Joe Biden launched a program called Additive Manufacturing Forward.

President Biden inspects large, printed aerospace components and meets with senior leadership from Sintavia, Lockheed Martin, and Honeywell in Cincinnati on May 6, 2022 to launch the new White House "AM Forward" supply chain initiative (from left to right, Frank St. John, COO, Lockheed Martin; Mike Madsen, CEO, Honeywell Aerospace; Brian Neff, Founder & CEO, Sintavia). Photo Courtesy: AP/Andrew Harnik

The initiative mainly aims to improve the supply chain and support the manufacturing sector in the USA. The vulnerabilities in the USA supply chain became critical after the COVID-19 crisis. Supply chain management became challenging mainly for the low volume high mix parts (LVHM) that are widely used in all types of industries. Additionally, it was identified by the government that critical sectors such as aviation and energy, automotive, medical device, and national security-related industries were also affected due to issues in the supply chain of LVHM. As AM technologies can reduce the lead times for the LVHM parts by 90%, AM forward's main aim was kept to improve the AM ecosystem in the USA with the main focus on improving the supply chain.

The article by AM Chronicle summarizes the key aspects of "Additive Manufacturing Forward" (AM Forward) and helps understand the role of the initiative for the economic development of USA and AM companies worldwide.

AM forward and the administrative goals

One of the critical administrative goals of the USA government is to develop more reliable and innovative supply chains. The second goal of the USA government is to ensure the growth of industries in future and to overcome the coordination challenge for new technologies. The third goal is to promote local manufacturing and innovations in the country.

The AM forward initiative believes that the AM technologies will help businesses and entrepreneurs innovate at a rapid phase, improve the productivity of manufacturing units by local production, and help develop the regional technology hubs. Overall, the government finds AM technology to be a significant technology for achieving long-term and short-term administrative goals.

Role of American companies in AM forward

The government of the USA has identified five iconic manufacturers as an initial voluntary partner of AM forwards, which are G.E. Aviation, Honeywell, Lockheed Martin, Raytheon, and Siemens Energy. As most of the small manufacturers in the USA are not using AM technologies, these companies will help develop the training and support facility for them. Additionally, they will also help in adapting the ability of AM technologies to produce spare parts in real-time, as this will improve the supply chain throughout the counties. They have also been identified for providing technical assistance to the supplier and developing standards and certification of AM parts. In general, the companies will act as a catalyst in developing AM infrastructure in the USA.

One of the critical points of the AM forward is that the initial voluntary companies will be committed to specific goals that will undoubtedly bring development in additive manufacturing infrastructure in the USA. For example, G.E. Aviation will target that the local AM suppliers fulfil 30% of its external AM sourcing in the USA. Raytheon will also encourage the SME manufacturer involvement in its quotes for AM products, Siemens Energy will purchase 20% -40% of its AM parts locally, Lockheed Martin will work to conduct research and development on AM technologies, and Honeywell will offer technical assistance to SME suppliers for AM.

How will AM Forward help to solve the key challenges in manufacturing?

Under the initiative, the government will provide SMEs with financial support to install AM equipment and machines. The 504 Loan Program and Small Business Investment Company (SBIC) initiative can be used to take the financial support. Additionally, the federal will also provide technical assistance and support to utilize the additive manufacturing capacity to the full extent. The Department of Energy will provide the support through its facility available at the Oak Ridge National Laboratory. The AM forward program also aims to provide skill training to the workforce for additive manufacturing.

Furthermore, a curriculum for training will be developed with the support of the U.S. Department of Labor to assist the manufacturers with programs in AM. As 3D printing is different from conventional manufacturing, it requires different standards. Hence, under the AM forward new standards will be developed with the participation of the U.S. Department of Commerce, ASTM International, American Society of Mechanical Engineers (ASME), International Organization for Standardization (ISO) and National Institute of Standards and Technology (NIST).

AM Forward an Open Initiative

The AM forward is a voluntary initiative and can be joined by anyone willing to make commitments to develop AM infrastructure. The initiative will be supported by the Applied Science & Technology Research Organization (ASTRO), a non-profit organization, and all the updates regarding the program will be shared on the ASTRO website.

References:

Using Additive Manufacturing to Improve Supply Chain Resilience and Bolster Small and Mid-Size Firms

FACT SHEET: Biden Administration Celebrates Launch of AM Forward and Calls on Congress to Pass Bipartisan Innovation Act

ASTRO- AM Forward

ABOUT THE AUTHOR

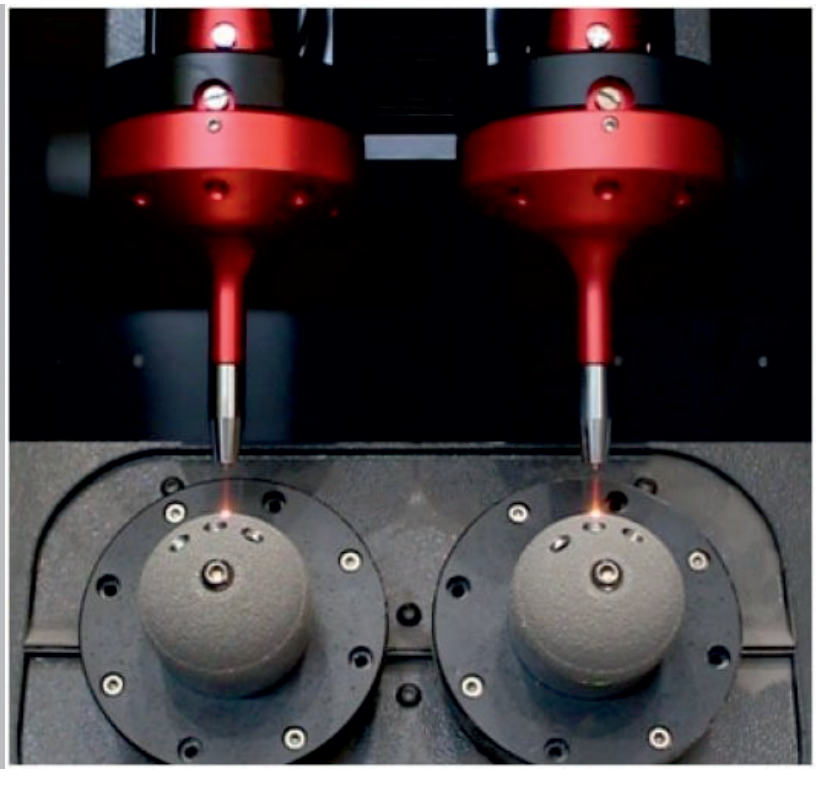
Chinmay Saraf

Technical Writer, AM Chronicle

Chinmay Saraf is a scientific writer living in Indore, India. His academic background is in mechanical engineering, and he has substantial experience in fused deposition-based additive manufacturing. Chinmay possesses an M.Tech. in computer-aided design and computer-aided manufacturing and is enthusiastic about 3D printing, product development, material science, and sustainability. He also has a deep interest in "Frugal Designs" to improve the present technical systems.

Artificial Joint manufactured using Metal Porous Coating Technology, a DED process received FDA approval

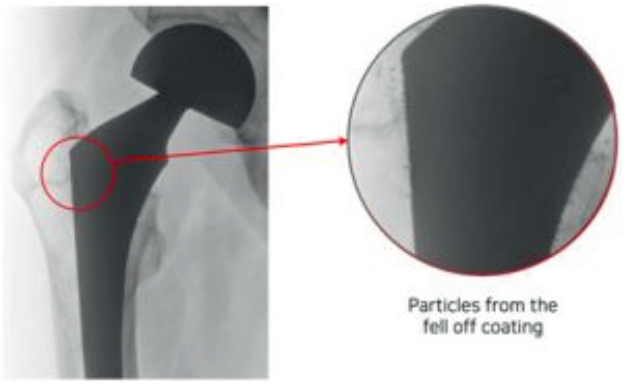
The article discusses the application of metal porous coating technology for production of artificial joints



InssTek, (based in Daejeon, South Korea) contributed to receiving FDA approval for an artificial hip joint and cup component manufactured using Metal Porous Coating (MPC) technology.

For artificial joints to bind to bones, a porous structure is required to allow bones to grow on the surface of artificial joints. In the existing artificial joint manufacturing method, titanium (Ti) powder was sprayed on the surface of the artificial joint using Titanium Plasma Spray (TPS) technology to

manufacture a rough structure. However, the artificial joint and titanium (Ti) powder are not completely bonded, and the bonding power of the coating layer is weak, therefore various problems have been reported.



Source: Dept of Orthopedic Surgery, Seoul St Mary's Hospital

Metal Porous Coating (MPC) technology is a technology that 3D prints patterns of porous structures on the surface of artificial joints using medical titanium (Ti) powder. Since MPC technology is developed from Direct Energy Deposition (DED) Metal 3D printing method, unlike conventional methods, artificial joints, and titanium (Ti) powders are completely melted and combined as one alloy. In addition, the pattern of the porous structure is manufactured by 3D printing, and the optimal roughness and pore structure can be expressed. Also, the quality of the coated artificial joints is constant.

InssTek succeeded in porous coating 'BENCOX Mirabo Z Cup Cortinium', an artificial hip joint cup component by Korean artificial joint company Corentec, using MPC technology. And obtained approval from the U.S. Food and Drug Administration (FDA).In addition, InssTek succeeded in applying MPC technology to cobalt-chromium (CoCr) alloy for artificial knee joints and artificial ankle joints, and further research is being conducted to apply MPC technology to various industrial fields such as semiconductors and aerospace.

Meanwhile, InssTek will participate in IMTS to be held in Chicago in September and FormNext to be held in Frankfurt, Germany in November to showcase various metal 3D printing technologies, including Metal Porous Coating technology.

ABOUT THE AUTHOR

Chinmay Saraf

Technical Writer, AM Chronicle

Chinmay Saraf is a scientific writer living in Indore, India. His academic background is in mechanical engineering, and he has substantial experience in fused deposition-based additive manufacturing. Chinmay possesses an M.Tech. in computer-aided design and computer-aided manufacturing and is enthusiastic about 3D printing, product development, material science, and sustainability. He also has a deep interest in "Frugal Designs" to improve the present technical systems.

3D Printing in the Middle East – From Hype to Hope!

Suneel Kashyap

The key factors and the future of additive manufacturing in the Middle East is explored in article

The 3D Printing market in the Middle East encompassing UAE, Kingdom of Saudi Arabia , Qatar, Kuwait & Oman has grown over the past years with various industries using 3D printers to produce Parts, prototypes and Models.

After a few years of closely delving in 3D Printing in UAE and Middle east market, the biggest question asked is Additive Manufacturing Disrupting the current Industry and if so, then what is the rate of adoption and in which Industry verticals?

The 3D Printing market in the UAE & Other countries in Middle east encompassing KSA, Qatar, Kuwait & Oman has grown over the past years with various industries using 3D printers to produce Parts, prototypes and Models. We can estimate the growth by directly linking the ratio of number of bureaus providing services and amount of variety of 3D printers being sold in the region.

Influencing Factors for growth of 3D Printing

- Increase in knowledge base & expertise

From 2017- 2018 edition of the State of 3D Printing, we can see a major shift in the level of expertise from the users and providers and the percentage of users considers themselves having intermediate knowledge or users/providers having good knowledge of the subject.

- Increase in 3D printing application – Polymers & Metals

We have focussed on how different 3D printing technologies, materials (metal 3D printing), and respective industry suitable postprocessing and surface finishes are being used. Not only did we see that plastic is still the most used material, and that more types of surface finishes on the end use parts are used in general manufacturing, The Metal application using DLMS technology has gained the traction, we are also witnessing some of the service bureaus are developing interesting case studies and end use parts with certification for respective industries in the use of metal for 3D printing, especially in Oil & Gas, marine and Offshore Industries.

- Increase in 3D printer purchases

We see that different adopters such as Students, architects, hobbyist, artists, designers, corporates, Industrial manufacturing companies, service bureaus and education institutions are investing on an regular basis to learn more and produce more of the components or parts as compared to just a few industry verticals in the past., we can see that people wish to use 3D printing for more applications. More number of technologies were introduced to market with different build capacity, material selection and faster production such as MJP, Desktop SLA, Faster DLP Printers and FDM with special Materials.

- Increase in the number of Service Bureaus

Few new Service Bureaus were introduced in just last year, not only in UAE, but in KSA, Kuwait, Oman Bahrain, Jordan and also the major development we saw was the increasing wish for businesses to hire calibre managers, operators and designers. We have also experienced different setups focussing on just a few 3D Printing technologies to provide excellent quality services and open up vital channels of mass and contract manufacturing.

- 3D printing for Scale models and other Manufacturing

When asked about, what are their top business sectors are when it comes to 3D printing in this region especially UAE, Scale Models and Prototypes still topped with majority of revenue streams as of today, however we simply can't ignore the potential and growth of the End user parts for manufacturing sectors since 3D printing offers the ability to offer mass manufactured products without the major costs that come along with traditional manufacturing methods.

In the UAE, the Dubai 3D Printing Strategy, Abu Dhabi's accelerated rate of adoptions in Manufacturing and construction industries and Sharjah;s Research park initiative aims to use the technology to maximise efficiencies and to go through a rigorous awareness creation program to introduce design thinking and manufacturability at the grass root level.

For the Manufacturing Sector with many opportunities on the horizon, companies can focus on these initiatives they'll invest to utilize additive manufacturing.

- Digitization, designing new parts for production- New Product Development
- on-demand production, restructuring of supply chains and reducing time-to-market.

Developing a new component or to reverse engineer and to create an improved design can require multiple iterations and prototypes before the customer's needs are met. 3D printing enables rapid prototyping and rapid manufacturing which can reduce the time it takes to build a prototype from weeks to just hours. Adoption of these technologies can help new parts move more quickly through the design cycle to production hence reducing significant costs and producing a part on-

demand with 3D printing enables manufacturers to print parts as needed and will help companies realize huge reductions in inventory and storage costs. Also, with 3D printing, the manufacturing process can speed up significantly, helping companies design, manufacture and increase the time to market

Applications for 3D printing in these markets will continue to increase in the future as today's usage and applications will be expanded by the capabilities of 3D Printing (Additive manufacturing) Industries such as aerospace where companies like Emirates, Ethiad and Strata have already begun incorporating the advantages of 3D printing at different levels of operations, Defence and Military sectors with their subsidiary units like Tawazun, Caracal and Nimr have already begun adopting 3D printing to produce better performing parts while minimizing costs. Universities/schools such as Khalifa university, AUD, AUS, UAEU, Zayed, HCT and other university continue to invest in their student applications and into their R & D Wing.

Medical and dental applications under the Influence of authorities of DHA, SEHA and in Hospitals Such as SKMC, NMC, Rashid, Burjeel Hospitals are being used to have better outcome on patient diagnosis and treatments.

It's not just these markets that has brought the opportunities, Jewellery and dental application have long been served with 3d printing technologies, new markets such as Consumer, Industrial, Interior design, fashion products and eyewear are all continuing to be disrupted by 3D printing.

There are some fascinating developments, since scale models, prototyping & production of end use parts are the most popular 3D printing applications in 2021/22 with R&D departments, universities being the most active adopters. Prototyping is experiencing rapid growth as evidenced by the percentage increase in adoption between 2018 and this current year. Adoption of 3D Printing in production environments is increasing, we have observed that offering customized products and services is also increasing as manufacturers rely on 3D printing to streamline and grow their mass customization. Manufacturing sector is also finding 3D printing can contribute to increasing production flexibility, further increasing sales and driving revenue growth.

Future of 3D Printing in the Middle East

In the Past, it was a relatively slow adaptive region for technology. The big challenges are some really big Industry verticals such as Construction (not only concrete 3D Printing) and Oil & Gas, however the local government totally understand where this might go and how they need to support helping transition some of these new ideas and strategies into effective adoption of this technology into mainstream manufacturing.

There is certainly an important role for 3D Printing in this region. we believe the real revenue, is in manufacturing applications. The real opportunity is how we can play a role in offering products and services around final-part production, versus making visual aid models and prototype parts.

3D Printing will grow through, increased applications in existing markets, expanded product applications new and additional opportunities from a varied market. Adopting and adapting this technology, will deal with various relevant fields including 3D content, cloud services, part-building services, design optimization and many more just like any other Industry and there will be excellent opportunities created for all skill levels in terms of Jobs and growth prospects in future.

ABOUT THE AUTHOR

Suneel Kashyap

Director at Layer X 3D Printing

Among the forefront of Industrial revolution 4.0 Suneel Kashyap is a fully accomplished, results driven and technically sophisticated professional with over 20 years of multi-disciplinary experience in UK, UAE & INDIA, focusing on offering solutions in 3D Printing (Additive Manufacturing)

An academically qualified master's degree holder in Rapid Product Development from the UK, Suneel Kashyap is an Additive Manufacturing (3D Printing) expert who is Passionate about developing long-term relations with the current and relevant industries.

Health, Safety and Environmental Considerations for Additive Manufacturing

Chinmay Saraf

This article explains various health and safety risk associated with additive manufacturing. Additionally, it also elaborates on the industrial safety measures that should be taken to overcome the potential risk.

In recent years the area of additive manufacturing (AM) has seen significant growth and development. The AM machines are widely used in industrial applications and education institutions to produce finished products directly from a digital model. But, the health and safety hazards are often neglected and not considered in the majority of areas of application.

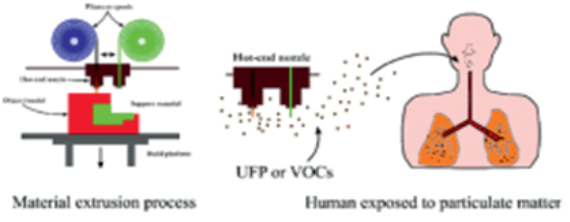
Recent studies have shown that AM machines can cause health and safety issues ranging from minor risks to life-threatening. This article by AM Chronicle explains the various health and safety risk associated with AM. Additionally, it also elaborates on the industrial safety measures that should be taken to overcome the potential risk.

AM Process and Risk

1. Fused Deposition Modelling

In fused deposition modeling, the filament is heated through a nozzle and deposited on the print bed. The popular materials used in fused deposition modeling are PLA, ABS, and nylon. Recently, composite materials, ceramics, and metal powders are also used as additional materials in PLA, ABS, and nylon. The main risk developed while using fused deposition modeling is the formation of volatile organic compounds when the polymer material is melted through the nozzle. Additionally, the use of acetone and other chemicals

during the post-processing process can also develop risks for human health. Some studies also suggest that the development of microparticles of polymer and add-ons such as ceramic, composite, and metal can also be inhaled during the printing process, which can develop respiratory issues. Accidents may also occur due to direct human contact with the hotbed or nozzle during or after printing. The use of safety chambers is recommended during the fused deposition modeling process.



Source: Hasanov et al. (2021)

2. Stereolithography

During stereolithography, a photopolymer material is selectively solidified using UV light. The photopolymer material, UV light, and post-processing method develop health risks while using this method. Some of the photopolymer materials are toxic, which may cause poisoning if consumed indirectly. Additionally, during the post-processing and curing stages, chemicals such as antimony, acrylates, and epoxies are released, which cause risks to human health. Direct contact with the UV light may result in skin cancer, eye damage, and skin damage. The use of personal protection equipment is recommended to reduce the health risk with stereolithography.

3. Powder Bed Fusion

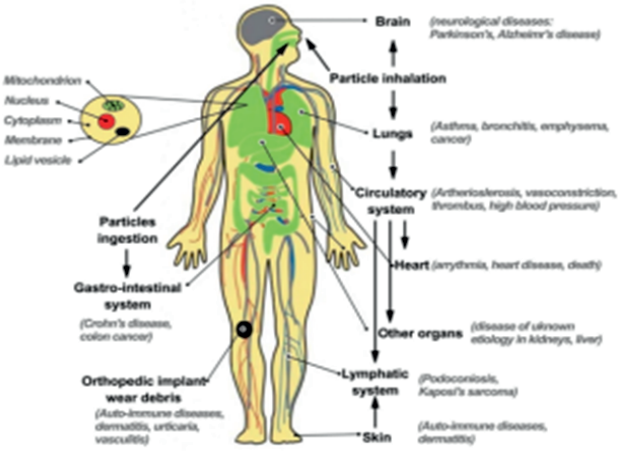
In powder bed fusion, an electron beam or laser is directed on metal powder to produce finished parts. The health risk in the case of powder bed fusion is developed due to the use of laser or electron beam, metal powder, and ionizing radiations. The metal powder used may range from the nanoscale to micro-scale, and indirect inhalation may cause serious respiratory issues for the user. Besides this, regular direct contact with ionizing radiation is a serious threat to the eyes and skin. The safety risk is developed if direct human contact has occurred during the printing process with the lasers or the electron beam. It may cause severe burns and damage. It is highly recommended that the printing process is done in a safe area with the powder bed fusion printing.

4. Direct Energy Deposition

The direct energy deposition method uses the characteristics of both fused deposition modeling and powder bed fusion to produce the finished parts. In direct energy deposition, a laser beam/electron beam is used to melt the material, which is deposited using powder or filament. The potential risk of direct energy deposition occurs due to ionization radiation and post-processing of the finished part. It is recommended to use safety chambers with personal protection gears for improved safety.

5. Binder Jetting

In binder jetting, a liquid material and powder materials are used to print the finished part. During the printing process, the liquid material acts as an adhesive that helps to develop the finished product. The formation of volatile organic compounds causes the health risk in binder jetting during the printing and post-processing. Additionally, in some cases, during the post-processing process, annealing is required to develop a high-quality product, which may result in an accident due to high



Source: Nozar et al. (2019)

temperature. The main risk is caused by direct inhalation of the liquid material or the powder materials used during the printing process. It is recommended that the process be performed according to safety standards and wear safety kits.

6. Material Jetting

Material jetting is a process in which material is sprayed onto a build platform and solidified under UV light. The health risk in the case of material jetting is caused by the use of UV lights, powder material, and the post-processing of the printed products. The risk is similar to the risk caused by UV light, powder materials, and the post-processing step.

7. Sheet Lamination

In sheet lamination printing, the sheet is used as a feedstock rather than powder, photopolymer, or filament material. Using lasers or other thermal sources to cut the sheet may cause a risk of injuries due to thermal sources and lasers. Other than this, the formation of micro powders during the printing process may also cause respiratory risk.

Source: Hasanov et al. (2021)

General Health and Safety Risk

Industrial-scale additive manufacturing machines are also associated with some general health and safety risks. They mainly include electric shocks, mechanical injuries, and thermal/heat injuries.

Electric Shocks

Electric shocks may occur due to loose wiring and the loose electrical fitting in the industrial machines. In the case of machines that use lasers or electron beams, electrical shocks are considered a life-threatening risk.

Mechanical Injuries

In the case of heavy additive manufacturing machines or machines that produce large volume parts, mechanical injuries can occur due to improper loading and unloading. The method of preventing mechanical injuries is proper training for the working staff.

Thermal/Heat Injuries

All the additive manufacturing processes are associated with thermal energy use, which causes a risk of thermal/heat injuries to the services. They can be protected by proper knowledge of the heating areas and training to the staff. The heated areas must also be insulated from the external source so that direct touching is prevented.

Conclusions

Additive manufacturing is a promising technology, but the discussion on health and safety for additive manufacturing is limited. Industrial accidents can be prevented by proper training, personal protection equipment, and safety kits. The manufacturers must also consider health and safety while designing the machines.

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3D printing can help the construction industry become carbon-neutral. Here's how

Slava Solonitsyn

Traditional construction is responsible for generating 27% of global CO2. Alternative methods such as 3D printing hold promise

Building our houses is hurting our home. Traditional construction is responsible for generating 27% of global CO2. Alternative methods such as 3D printing hold promise, but there is work to do before construction is truly environmentally-friendly.

Highlights

- The construction industry is responsible for generating 27% of global CO2 emissions. How can we make it more sustainable?
- 3D printing offers a potential solution, but can only become truly sustainable if materials and processes are also ecologically sound.
- Progress will require collaboration between regulators and industry leaders, who should actively engage to ensure numerous standards are updated regarding the use of alternative construction materials.

3D printing is an industry that is already sustainable right now. The process produces a fraction of the waste

of traditional construction manufacturing, because builders simply print exactly and only what they need. It only requires a small factory with minimal space for storage materials, and unlike a traditional production line, 3D printing does not require energy to move the same parts from one step to the next.

However, some builders using green processes still rely on traditional materials, such as cement. Cement alone is responsible for 8% of global CO2 emissions, virtually eliminating any positive impact on the environment that 3D printing can deliver.

The benefits of alternative construction methods like 3D printing are clear

Sustainable materials are already available today. For example, polymer composite is as strong and durable as concrete – the synthetic stone developed by Mighty Buildings weighs 30% less than concrete and has five times the tensile and flexural strength. These innovative materials can be stored in compact liquid or semi-liquid form in barrels, which helps keep factory footprint small. The environmental benefits continue once a building is printed, as polymer composite is a superior insulator to traditional materials, minimizing the emissions of the house during its lifetime, as it's lived in and used.

Despite the benefits of alternative construction methods using sustainable materials, their widespread use still requires support from regulators, customers, and the builders themselves.

With rising housing costs regularly making headlines, pricing is a barrier to widespread customer demand for greener construction alternatives. While it's true that new generation housing currently costs more than traditional construction, as scale increases and 3D printed construction continues to become more efficient, the prices will lower, achieving an economy of scale. Furthermore, buyers willing to make a sustainable investment in their home purchase will receive long term costs benefits, as green homes have higher asset value, lower long-term utility costs and are more resilient during extreme weather and natural disasters.

Promoting sustainable materials and processes

With customers increasingly embracing sustainable construction, builders should and likely will make 3D printed homes more widely available. This is challenging though – many market participants representing various categories would need to be actively involved in changing the industry. For existing construction companies with deeply entrenched business models, transitioning to a greener model could take decades, but frankly, they don't have that much time. Cement production is the third biggest generator of CO2 emissions, more than any individual country except for China and the US. Mining for cement is incredibly destructive to the environment, and obtaining the sand necessary for concrete and cement production is also harmful and increasingly difficult, as demand is outpacing supply.

Decarbonising the process is extremely challenging, because the chemical processes used to produce cement concrete release CO2. Rather than retrofitting a centuries old technology to be sustainable, it is time to embrace sustainable alternatives and explore other breakthrough material. Traditional construction companies should lead the industry and leverage their market power to promote sustainable materials and processes for everyone's benefit.

Regulations are the other key barrier to the advancement of sustainable construction alternatives. As often happens with innovation, the technology is moving faster than the laws can keep up, and there are many layers in the highly regulated construction industry, including local building codes, permitting, inspection authorities, and contract provisions. Progress will require collaboration between regulators and industry leaders, who should actively engage to ensure numerous standards are updated regarding the use of alternative construction materials made using 3D printing or other means. Tech talent at startups may be more willing to disrupt the conservative industry

model and could prove to be a driving force of sustainable development.

Embracing green construction alternatives

The new generation of sustainable home builders have the tools they need to make the construction industry greener, however, to accelerate the shift to environmentally friendly housing they need to partner with regulators and developers. Ultimately, achieving carbon-neutral construction will come down to customer demand and big builders' willingness to embrace greener alternatives and pave the way for widespread implementation.

Original Source: World Economic Forum (https://www.weforum.org/agenda/2022/06/3d-printing-can-help-make-construction-carbon-neutral-heres-how/)

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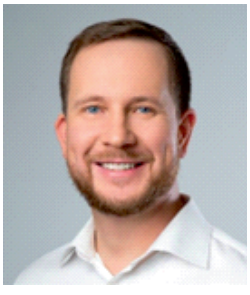

Slava Solonitsyn

Cofounder and Chief Executive Officer, Mighty Buildings

Slava started Mighty Buildings in 2017 being inspired by the idea to solve the global housing shortage problem with 3D printing and automation using a sustainable approach. He oversees day-to-day operations as well as strategy development and capital raising. Slava has more than 10 years of successful experience as an investor in promising startups across industries. He was a venture and managing partner at Singapore-based seed firm Ruvento Ventures which invested in a number of US-based startups including PreNav (digitising critical infrastructure), Eight Sleep (smart mattress) and Revl (smart action camera). Slava holds MBA in entrepreneurship and venture capital of Imperial College London and MSc in physics from Nizhniy Novgorod State Technical University.

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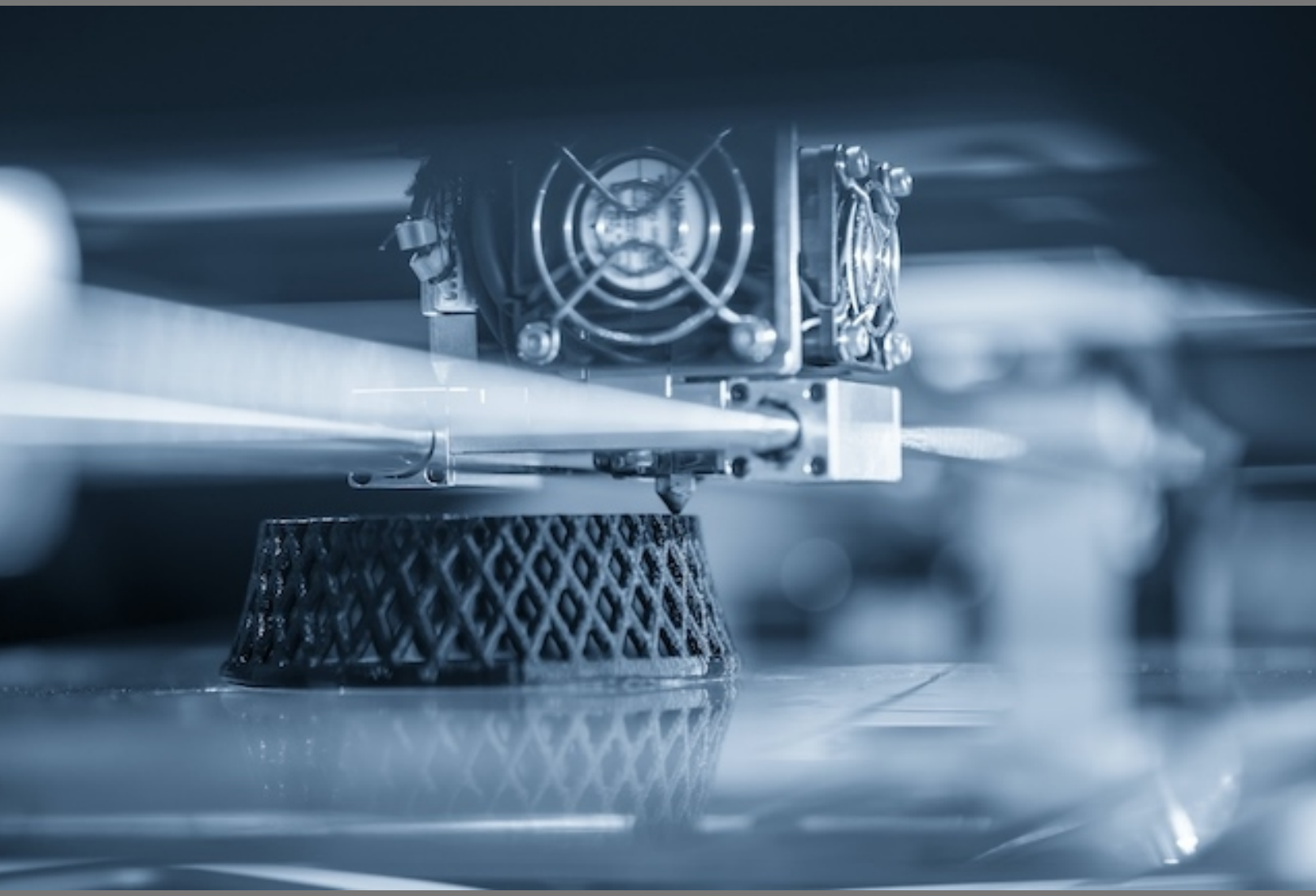
AM STARTUP SERIES



Startups are key for the next wave of disruptive growth for additive manufacturing. AM Chronicle is coming together with AM Ventures, a leading global venture capital firm dedicated to industrial 3D printing for AM Startup Content Series

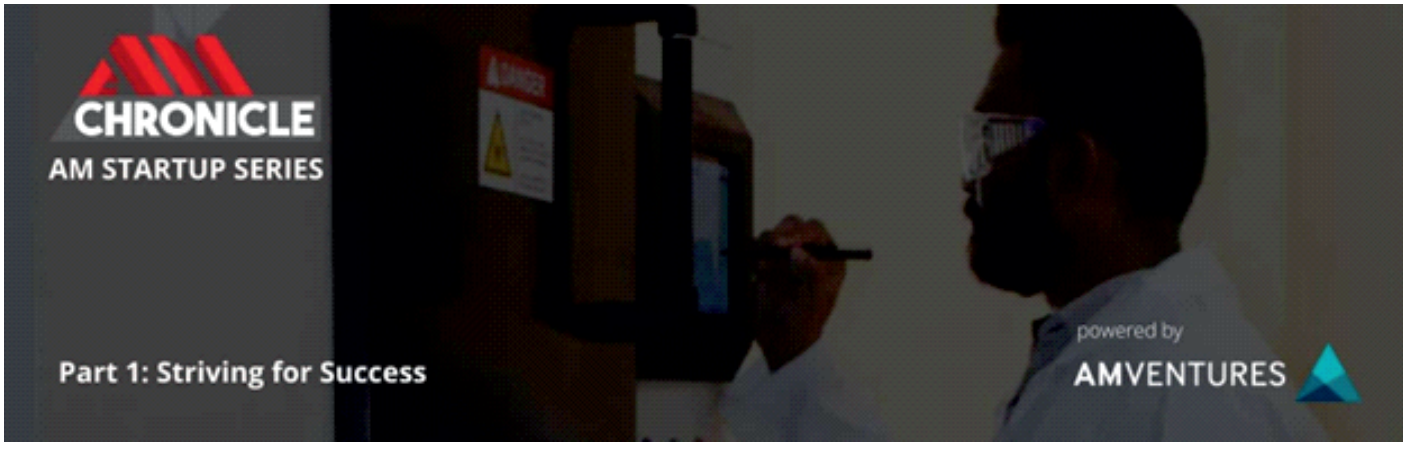
powered by

AMVENTURES

Striving for Success: Prayasta develops solution for personalized 3D printed soft-tissue implants

Aditya Chandavarkar, Vaishali Heblekar

In this special Startup Saturday article as part of the AM Chronicle Startup Series powered by AM Ventures we connect with the Co-Founders of Prayasta to understand more about their venture



Prayasta was founded in 2017 by Vikas Garg (CTO) and Shilpi Sen (CEO) to develop a solution for personalized 3d printed soft-tissue implants.

In this special Startup Saturday article as part of the AM Chronicle Startup Series powered by AM Ventures we connect with the Co-Founders of Prayasta to understand more about their venture.

In a Nutshell

Prayasta was founded in 2017 by Vikas Garg (CTO) and Shilpi Sen (CEO) to develop a solution for personalized 3D printed soft-tissue implants and prosthesis for breast cancer survivors. This eventually evolved to cover all soft-tissue implants (nasal, chin, malar etc.) and even silicone stents (tracheobronchial, oesophageal etc.). Prayasta is also developing a Point-of-Care silicone 3D printer along with their Pro-version which is meant for full-scale production. Their technology, 'implant-grade' Elastomer Additive Manufacturing (iEAM) is at a pre-clinical stage currently. Novel Internal Architecture (NIA) is another aspect of their innovation which is a design methodology specifically developed for silicone 3D printing and soft-tissue implants. Prayasta has been granted patents for its technology in India and USA, and has filed a patent in Europe too.

Brains behind this

Meet Vikas Garg and Shilpi Sen, the brain behind Prayasta. Vikas is a material scientist with 6+ years of experience in 3D printing advanced materials including biomaterials, while Shilpi is a communications expert with 15+ years of experience in both, the public and private sector. Prayasta has an inter-disciplinary and agile R&D team of 4 with expertise in machine design, electronics hardware, firmware and implant design.

"Prayasta is a National Technology Award winning and women-led startup and has developed a 3D printing technology for implant-grade silicone for making personalized prostheses and implants. We strongly believe that solutions should fit to the people rather than people fitting into the solutions." – Shilpi Sen, Co-Founder, Prayasta

The Before and The After

3D Printed Soft Tissue Implant

The biggest current challenge with the implants that are meant to replace soft tissues as in breast, trachea, lip, chin, malar etc. is the lack of any personalization or customization. Consider the case of a silicone tracheal stent which is used as a replacement for part of the trachea. Most of them have a Y shape, uniform diameter and are available in limited sizes while in reality, tracheas rarely have a uniform diameter or branches limited to two. Second scenario is for breast and facial implants where most of the time only one side of the organ needs a replacement. In such cases, expectation from implants is to perfectly restore the body symmetry and physical appearance which again cannot be achieved using standard products made elsewhere. Third scenario where personalization is required, is for paediatric surgeries since kids being in various age groups comes in all sizes. That is why, Prayasta focuses on creating implants that fit to people rather than fitting people to existing implants.

The real reason for lack of personalization is the age-old manufacturing techniques for silicone products. While for other polymers and metals, 3D printing is shifting the trend from mass production to mass customization, a professional 3D printer for implant-grade silicone still does not exist due to various technical challenges when it comes to 3D printing silicone.

"Silicone is one of the best implantable materials today and yet not 3D printable. Conventional printers can not handle silicone due to its inherent chemical nature, cross-linking mechanism and form factor. That is why, we have taken a fresh approach and developed a novel technology for printing implant-grade silicone." – Vikas Garg, Co-Founder, Prayasta

Technology Tales

Prayasta has completed its R&D for the world's first 3D printer for implant grade silicone which is called Silimac P250. Using Silimac P250, Prayasta has developed a prototype of various implants, prostheses, and stents such as breast, lip, chin, malar and tracheal stent. Prayasta has also completed several in-vitro studies

using their prototypes and are now completing animal trial phase.

Silimac P250

Silimac P250 and its associated technology iEAM is significantly different than other 3D printing technologies in many ways. Firstly, it is obviously silicone material. All the 3D printers that are available in the market today can print either a thermoplastic, a photoactive polymer or a metal/alloy. However, silicone material does not resemble either of these materials in its characteristics and hence cannot be printed using conventional 3D printers. Second aspect is the grade of the material. While other machines print industrial grade of the materials, Silimac P250 is capable of printing implant grade silicone that are suitable for long-term of implantation in humans. Third biggest differentiator is the speed and the scale at which this is done. Silimac P250 is a medical clean room ready, production grade machine that can handle up to 14 litres of raw material at a time and print at 3x faster speed in comparison to any other elastomer printer.

In term of implants, 3D printed implants are personalized not only in terms of shape and size, but also in terms of weight, touch, feel, stiffness. At the same time, 3D printed breast implants having NIA are an order safer for patients in comparison to conventional ones as these are leakproof and suturable.

AM Ventures Asks

Along with the Technological innovations, it is important for start-ups to understand how their innovation is addressing the world's biggest Environmental, Social and Governance Challenges. AM Ventures, our co-collaborator for this AM start-up series, poses a question to Prayasta on their contribution to the world's biggest ESG challenges.

One of the problems that Prayasta addresses through its personalized 3D printed soft-tissue implants is after-effects of breast cancer. Breast cancer is the most diagnosed cancer among women in the world with more than 2 million cases annually and India represents no exception to this trend with ~0.2 million cases annually. Around 80% of these women undergo mastectomy that is removal of a breast. Mastectomy is just not about removal of a breast. It causes significant depression, emotional distress, loss of body image and also self-confidence. Women tend to reduce their participation personally, professionally, socially as they are afraid of being stigmatized for a disease which is no fault of theirs. They become too conscious about their appearance and always tend to hide the mismatch or asymmetry caused by the mastectomy. Prayasta addresses this social problem which eventually becomes the seed for gender inequality and gender based social exclusion.

AMVENTURES

What do you believe is your company's contribution to addressing the world's biggest Environmental, Social and Governance (ESG) challenges?

Funding Facts

Prayasta had bootstrapped and got support through various grants till now, such as Nidhi Prayas, Biotechnology Ignition Grant, Design Clinic Scheme, Tide 2.0, Elevate Call 2, with few more in the pipeline.

Prayasta is currently raising funds through private investments.

They seek:

Raising funds and getting associated with mentors with domain expertise.

Contact Details

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Email: vikas@prayasta.com; shilpi@prayasta.com
Contact: +917411359365, +919811710152

A Quick Recap

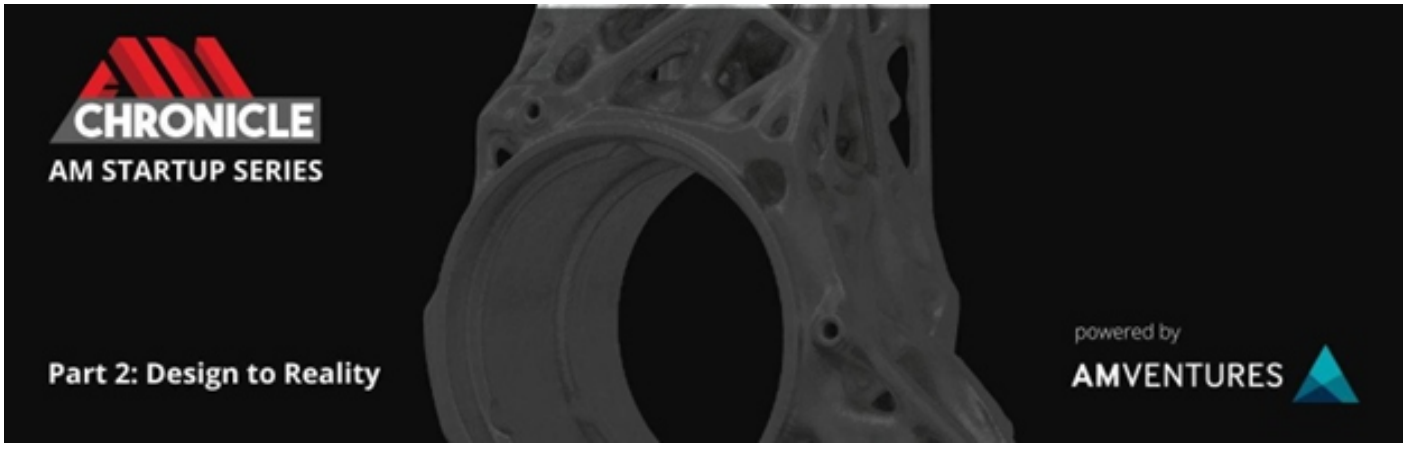
- Founded in 2017 by Vikas Garg (CTO) and Shilpi Sen (CEO) to develop a solution for personalized 3D printed soft-tissue implants and prosthesis for breast cancer survivors.
- Scope covers all soft-tissue implants (nasal, chin, malar etc.) and even silicone stents (tracheobronchial, oesophageal etc.).
- Developing a Point-of-Care silicone 3D printer along with their Pro-version which is meant for full-scale production.
- Their technology, 'implant-grade' Elastomer Additive Manufacturing (iEAM) is at a pre-clinical stage currently.
- Novel Internal Architecture (NIA) is another aspect of their innovation.
- Granted various patents for its technology in India and USA, and filed a patent in Europe too.
- Focuses on creating implants that fit to people, rather than fitting people to existing implants.
- Shifting the trend from mass production to mass customization.
- Completed its R&D for the world's first 3D printer for implant grade silicone which is called Silimac P250.
- Silimac P250 and its associated technology iEAM is significantly different than other 3D printing technologies in many ways.
- 3D printed implants are personalized not only in terms of shape and size, but also in terms of weight, touch, feel, stiffness. They are also leakproof and suturable.
- Addresses the social problem related to breast cancer, which eventually becomes the seed for gender inequality and gender based social exclusion.
- Bootstrapped and got support through various grants such as Nidhi Prayas, Biotechnology Ignition Grant, Design Clinic Scheme, Tide 2.0, Elevate Call 2, with few more in the pipeline. Currently raising funds through private investments.
- Seeking to raise funds and get associated with mentors having domain expertise.

Disclaimer: This AM Chronicle Startup series is powered by AM Ventures and companies mentioned in the series are not necessarily funded or supported by AM Ventures directly, unless otherwise mentioned.

Design to Reality: Cognitive Design Systems optimizes design for Additive Manufacturing using AI

Aditya Chandavarkar, Vaishali Heblekar

Cognitive Design Systems aims to revolutionize product design, by enabling engineers to generate and optimize 3D models or design for different manufacturing methods using Artificial Intelligence.



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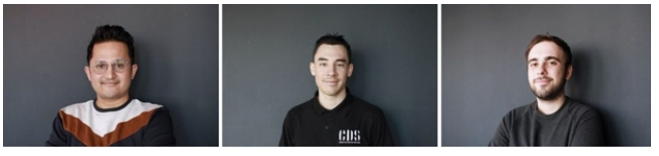
In this special Startup Saturday article as part of the AM Chronicle Startup Series powered by AM Ventures we connect with the Co-Founders of Cognitive Design Systems to understand more about their venture.

In a Nutshell

The story of Cognitive Design Systems (CDS), an engineering software company, began in March 2021. A continuation of software solutions that were commercialized in Japan in 2018, CDS aims to revolutionize product design, by enabling engineers to generate and optimize 3D models or design for different manufacturing methods using Artificial Intelligence (AI). The set of algorithms and the solution offered allows users to perform feasibility studies, predict manufacturing risks, cost estimation, as well as 3D modelling such as generative design and other optimization techniques necessary when conceiving a product. Ensuring manufacturable design, CDS brings your 3D concept from design to reality. CDS is a team of 11 people serving clients in Japan, Europe and North America.'

Brains behind this

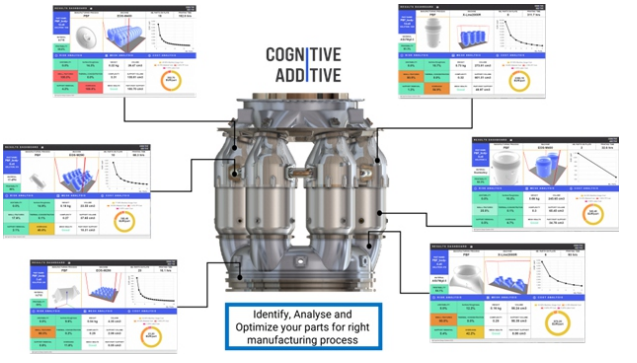


Based in Toulouse, France, CDS was created by the terrific trio, Rhushik Matroja, Henri de Charnace and Vincent Ung, the three co-founders of this organization. Rhushik and Henri have a combined 12 years of experience in Additive Manufacturing, and have worked on more than hundreds of projects ranging from aerospace, defence, automotive, consumer and medical industry.

"CDS creates machine learning algorithms which brings insights from manufacturing world to the design board of an engineer. Our algorithms analyse, optimize and validate parts for manufacturability, performance and cost based on decisions made by the engineer. Our dream is to create a platform where engineer Co-Designs with AI." – Rhushik Matroja, Co-Founder, CDS

The Before and The After

While working with clients, CDS noticed the gap between engineering designs and manufacturing feasibilities, making the design cycle lengthy or inefficient. Therefore, CDS accelerates the design to manufacturing process through automation, while reducing the steps required to optimize a design. Developing machine learning algorithms, optimized designs are generated that are ready to be manufactured. AI will allow engineers to explore a full range of design options based on their requirements, and ultimately choose the best design for their project. The ultimate goal is to build the best all-in-one generative design platform for additive and conventional processes, providing a holistic approach to modern engineering.



Technology

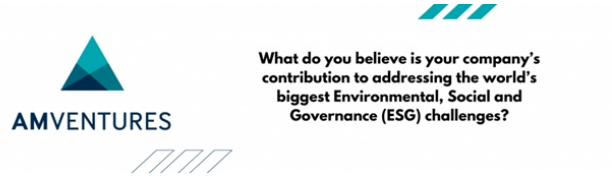
The key differentiating technology is their ability to design in harmony with AI and automation. This ability to master 'generative-manufacturable' design, that is fit for manufacturing, makes it unique. The software converts concept designs into a manufacturable and economically viable products using machine learning algorithms. The CDS platform aspires to democratize the access to design engineering, a service usually limited to large companies that can afford engineering consulting fees. The automated platform helps to bring innovation and creative product to the market in no time, while reducing the entry cost for advanced engineering design.

"In a world that is increasingly automated by AI and new technologies, we leave the tedious process of figuring out optimal designs for manufacturing to our machines. Spend time on what is important, and conceive innovative designs and ideas that are worthy of the 21st century. Imagine all the possibilities that await, and make your concept a reality today."

AM Ventures Asks

Along with technological innovations, it is important for

start-ups to understand how their innovation is addressing the world's biggest Environmental, Social and Governance Challenges. AM Ventures, our co-collaborator for this AM start-up series, poses a question to Cognitive Design Systems (CDS) on its contribution to the world's biggest ESG challenges.



As a start-up, they recognise the ESG challenges in the context of the manufacturing industry.

The rise of additive manufacturing has contributed to the emergence of many technological breakthroughs: improving production processes to be more efficient, less resource intensive production due to optimized design, using innovative materials, more accurate printing that reduces waste, with regards to the impact on our planet.

As part of integrating new processes and materials in the Cognitive Additive software (a second version of their software), CDS is exploring the introduction of an ecological aspect, such as a carbon footprint KPI, available in its 'Results' section. Manufacturing a product is not only about cost and lead time, it is about creating a better product that is efficient and durable without compromising the integrity of its design.

Funding Facts

In December 2021, CDS released the second version of their software called 'Cognitive Additive' to broaden their product commercialization from Japan to Europe. The team collaborated on numerous projects with notable industry players (Velo3D, nTopology, Ansys, to name a few), and clients from various sectors such as well-known aircraft manufacturers, major sports equipment suppliers, and defence companies. Currently, CDS is solely owned by the founding team. The start-up is excited to begin its first round of funding, anticipated for the second half of the year.

They seek:

Investors sharing their vision and objectives. They are also looking for collaboration and partnerships from software editors to machine makers. Since they are looking to expand in North America, they seek companies and people familiar with that region.

Contact Details

Rhushik Matroja (CEO)
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A Quick Recap

- An engineering software company that began in March 2021, as a continuation of software solutions that were commercialized in Japan in 2018.
- Aims to revolutionize product design, by enabling engineers to generate and optimize 3D models or design for different manufacturing methods using Artificial Intelligence (AI).
- The set of algorithms and the solution offered allows users to perform feasibility studies, predict manufacturing risks, cost estimation, as well as 3D modelling such as generative design and other optimization techniques necessary when conceiving a product.
- Manufacturable design that brings your 3D concept from design to reality.
- A team of 11 people serving clients in Japan, Europe and North America.
- Created by the terrific trio, Rhushik Matroja, Henri de Charnace and Vincent Ung, the three co-founders of this organization.
- While working with clients, CDS noticed the gap between engineering designs and manufacturing feasibilities, making the design cycle lengthy or inefficient.
- Accelerating the design to manufacturing process

through automation, CDS also reduces the steps required to optimize a design.

- The ultimate goal is to build the best all-in-one generative design platform for additive and conventional processes, providing a holistic approach to modern engineering.
- The key differentiating technology is their ability to design in harmony with AI and automation.
- Mastering 'generative-manufacturable' design, that is fit for manufacturing, makes it unique.
- The automated platform helps to bring innovation and creative product to the market in no time, while reducing the entry cost for advanced engineering design.
- The rise of additive manufacturing has contributed to the emergence of many technological breakthroughs: improving production processes to be more efficient, less resource intensive production due to optimized design, using innovative materials, more accurate printing that reduces waste, with regards to the impact on our planet.
- As part of integrating new processes and materials in the Cognitive Additive software (a second version of their software), CDS is exploring the introduction of an ecological aspect, such as a carbon footprint KPI, available in its 'Results' section.
- Manufacturing a product is not only about cost and lead time, it is about creating a better product that is efficient and durable without compromising the integrity of its design.
- In December 2021, CDS released the second version of their software called 'Cognitive Additive'.
- Currently, CDS is solely owned by the founding team. Excited to begin its first round of funding, anticipated for the second half of the year.
- Seek investors sharing their vision and objectives, looking for collaboration and partnerships from software editors to machine makers. Since they are looking to expand in North America, they seek companies and people familiar with that region.

Disclaimer: This AM Chronicle Startup series is powered by AM Ventures and companies mentioned in the series are not necessarily funded or supported by AM Ventures directly, unless otherwise mentioned.

ABOUT THE AUTHOR

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Co-founder - AM Chronicle

Aditya Chandavarkar is a established entrepreneur with business interests in manufacturing, innovative technology, training consulting. He is closely associated with cutting edge application industries for inkjet, 3D Printing (Additive Manufacturing) and Packaging.

ABOUT THE AUTHOR

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An experienced content writer with a strong background in communications and branding. Vaishali also brings with her work experience in Corporate Communications in the manufacturing industry. Skilled in corporate and creative content writing, proof-reading and editing. Also adept at translation from Hindi and/or Marathi to English. Strong communication professional with a masters from Xavier Institute of Communications, Mumbai.

Hydraulic manifold for aerospace redesigned for additive manufacturing with Objectify Technologies

The article discusses the case study of redesigning hydralic manifold for aerospace by Objectify Technologies

Additive manufacturing (AM) is highly suited for the design and manufacture of manifolds due to its ability to build internal features and passageways.

Objectify Technologies has collaborated with a customer to redesign their current hydraulic block manifold with Additive manufacturing in mind.

The main goal of the 3D Printing project was to reduce the mass of the component whilst retaining its robustness. Due to the increased design freedom associated with AM, an opportunity to increase the efficiency of the flow paths was also identified.

We're going to share with you how Objectify

Technologies optimize the given design by the company to reduce the weight while considering the loading constraints.

The Aerospace Industry is the research, development, and manufacture of flight vehicles and space crafts. It produces Airplanes, spaceships, uncrewed aerial vehicles (UAVs), etc. Technical innovation is the trademark of this industry.

In the aerospace industry, efficiency is a major concern; one way to increase efficiency is by reducing weight of the part.

What is a hydraulic block manifold?

Hydraulic Manifold is used in the aerospace industry to regulate the flow of fluid in a Hydraulic system which helps us control the transfer of power between actuators, pumps and other components in the system.

Traditional manufacture of hydraulic block manifolds

Traditionally, hydraulic block manifolds are manufactured from an aluminium alloy or stainless steel billet which has been cut and machined to size, followed by drilling to create the flow pathways. Specialised tooling is often needed due to the complex drilling that is required. Passages require blanking plugs to properly direct flow through the system.

The nature of the manufacturing process results in abrupt angled junctions between flow paths which can cause flow separation and/or stagnation – a major contributor to efficiency loss.

What material is used to print the hydraulic block manifold?

The material used to build is an age-hardening cast aluminum alloy that provides good hardness, strength and dynamic toughness.

Aluminium alloy manifolds are generally less costly due to lower material costs and ease of machining, however they can be less abrasion resistant, and so any loose particles in the flow will abrade the surface and increase wear. For this reason, stainless steel manifolds are sometimes more desirable, however due to the higher density and hardness of stainless steel compared to aluminium alloy these come with a significant weight increase and added cost of machining.

Benefits of AM for the design and manufacture of Hydraulic manifolds:

- Optimised flow paths for a more efficient component functionality
- Reduction in the requirement for fixturing
  Minimal requirement for removable support structures
- Significant weight reduction is achievable
  No requirement for block extraction passages
- With full design freedom a manifold can be designed to pack into a significantly smaller volume

Direct benefits to customer:

- Mass reduction of up to 30%
- Single piece construction, fewer opportunities for defects
- Rapid design and development iterations
- Compatibility with existing design
- Improved flow efficiency of up to 60%

First design iteration

The previously provided part design is modified into a new one by design optimization by using simulation software –

Rhinoceros 3D >> Design Modification
MSC Apex >> Design Optimization
Materialize Magics >> Data Preparation
Simu fact Additive>> Build Simulation

by elimination of all the unnecessary drill channels and substituting it with more simpler designs, by

modification of critical areas and redesign of internal channels for manufacturability by Additive Manufacturing in the considered orientation.

Results summary

Design stage	Material	Mass (kg)
Original hydraulic manifold	Aluminum alloy	21
Design for AM	Aluminum alloy	14.9

The modified design is then put through simulation. After final iteration Maximum Stress on Component was observed to be "267 Mega Pascal".

The original weight of the manifold was 21 Kilograms. We were able to reduce its weight by "6.1 Kilograms" which is about "30%" of the initial weight.

The final weight after optimization was "14.9 Kilograms". Final changes are made to the design and are made ready to print by adding appropriate stocks and supports to the design. And is fed to the 3D printing machine for printing.

After the printing is completed and the cooldown time, the part is taken out; post processing activities begin. Build Plate removal and then manual powder removal is completed.

Then the part is inspected for any defects in the print. The dimensions and quality of the print is checked for any errors.

Thus, we were successfully able to create the hydraulic manifold which is more efficient, simpler structure and lighter in weight using Additive Manufacturing technology.

ABOUT THE AUTHOR

Objectify Technologies Pvt. Ltd

Objectify Technologies Pvt. Ltd is one of the leading 3D printing companies in India offering varieties of materials, best customer service and shipping options.

New Additive Manufacturing standard for medical device manufacturing

The application of additive manufacturing is constantly increasing in the healthcare sector, the article discusses recent development in standards for healthcare.

A new ASTM International standard will provide guidance to medical device manufacturers on the use of powder reuse in powder bed fusion manufacturing processes. ASTM's additive manufacturing technologies committee (F42) developed the standard, which is now available as F3456.

According to ASTM International member Matthew Di Prima, the new standard explains seven broad reuse schema that will give manufacturers information pertinent to regulatory bodies interested in understanding how powder reuse schemes affect medical device performance.

"Additive manufacturing manufacturers of medical devices and regulatory bodies will find this new guide to

be useful," says Di Prima. The guide may also be useful to AM manufacturers to generally describe their reuse process to customers without having to give away specific manufacturing process information."

F3456 is the first standard to be developed by the F42's additive manufacturing subcommittee on medical/biological standards. The subcommittee welcomes wider engagement in developing standards on the use of AM material specification for medical applications.

To purchase standards, contact ASTM International customer relations (tel +1.877.909.ASTM; sales@astm.org).

Standardizing additive manufacturing for the energy and maritime industries

Stian Saltnes Gurrik

A joint industry project to standardize and optimize qualification processes for Additive Manufacturing (AM), reducing cost and environmental impact of production through AM, and enable the use of AM in applicable design applications in the Energy and Maritime sector.

DNV's ProGRAM JIP concludes its 2nd phase and embarks on new industry challenges in the standardization of Additive Manufacturing (AM) for the Energy and Maritime industries. Phase 3 of the joint industry project will kick off in June 2022 with industry partners representing the whole value chain.

Since the kick-off of the ProGRAM JIP phase 1 in January 2018, the Joint Industry Project has over two phases developed, and later improved, a guideline for qualification of AM processes and parts. The JIP guideline was released as DNV-ST-B203 – Additive manufacturing of metallic parts, and will be revised with the latest updates later this year. The standard is bringing us closer to using AM on an industrial scale through defining conventional qualification processes,

but also opening doors to new ways of doing qualification and quality control. However, there are still challenges to be solved before additive manufacturing can be used at its full potential in the Energy and Maritime industries.

Phase 2 of the joint industry project, recently concluded, have added provisions to DNV-ST-B203 so that the next edition of the standard will cover the following AM technologies:

- Directed energy deposition using electric arc, and laser beam (DED-arc and DED-LB)
- Powder bed fusion using laser beam and electron beam (PBF-LB and PBF-EB)
- Binder Jetting (BJT)

The new edition of DNV-ST-B203 will also include:

- Requirements for the qualification of combined manufacturing methods, such as AM features on substrate shapes
- Defined acceptance criteria for defects
- Guidance on the definition of part families
- Guidance on the choice of criticality classes (AMC)
- Use of unconventional inspection techniques and in-process monitoring.

ProGRAM JIP phase 3 will form a consortium representing the whole supply chain, including field operators, EPC contractors, design owners, AM manufacturers, AM machine manufacturers and AM consumable suppliers. Through conducting real case studies, the JIP aims to build provisions for DNV-ST-B203 on the following topics:

- **Design for Additive Manufacturing -** Bridging Additive Manufacturing to conventional design standards and material data sheets
- **Repair / remanufacturing -** Offering a sustainable alternative using additive manufacturing
- **Post-processing programs -** Identifying recommendations and challenges related to post-processing, i.e. feedstock handling, processing steps, heat treatment programs
- **Part families -** Ensuring flexible build process qualifications to re-use qualifications for similar parts by defining families of parts

In the DNV AM advisory team we believe additive manufacturing is an enabler. An enabler for replacing physical assets with digital assets. An enabler for quality control through monitoring instead of testing or inspection. An enabler for local manufacturing in a global market. An enabler for reducing our greenhouse gas emissions and waste from manufacturing and logistics. An enabler for performance-oriented designs. There will be challenges along the way, but we are looking forward to working on solving them together with the industry.

ABOUT THE AUTHOR

Stian Saltnes Gurrik

Senior Engineer, DNV

Stian Gurrik is a Senior Engineer at DNV based in Oslo and has expertise in Materials technology, welding, NDT, additive manufacturing, failure investigation, standardization, qualification of suppliers

The Landscape of Metal Additive Manufacturing

This article by AM Chronicle elaborates on the landscape of the metal AM technology, and highlights the major companies associated with the technology, the market share, and growth opportunities.

This article by AM Chronicle elaborates on the landscape of the metal AM technology, and highlights the major companies associated with the technology, the market share, and growth opportunities.

Metal additive manufacturing (AM) has tremendous potential to fulfill the current industrial needs. The technology has grown from a concept to advanced machines that can develop highly complex components. The market size of the metal AM is also expanding rapidly with new technologies and companies investing in the sector.

This article by AM Chronicle elaborates the landscape of the metal AM technology, and it shares highlights of the companies associated with the technology, the market share, and growth opportunities.

Categorization of Metal Additive Manufacturing Technologies

Material Extrusion

Material extrusion or fused deposition modeling is the method that is commonly associated with polymer printing, but the recent development in the technology has enabled metal AM with the help of the material extrusion process. In this method, metal power with polymer material is extorted on the print bed, and the

printed product undergoes post-processing methods to develop the finished product. The polymer materials generally used PLA or ABS with aluminum, copper, iron, or brass powders. The main application of this method is in-circuit fabrication and areas in which higher thermal conducting material is required.

Powder Bed Fusion Technology

The power bed fusion technology covers the majority of the market share of metal AM. The laser selects metal power on the print bed to develop the finished product in this method. Commonly, the process is classified into four types: direct metal laser sintering, selective laser melting, electron beam melting, and direct metal laser melting. The methods are selected based upon the metal needed to be printed and the accuracy of the printed part required.

Direct Energy Deposition

In direct energy deposition, thermal energy sources selectively melt the feedstock. The melted feedstock is deposited on the print bed and solidified. Further, the layer-by-layer solidification ensures that the part is printed per the given commands. The standard processes used in direct energy deposition are electron beam additive manufacturing, wire and arc additive manufacturing (WAAM), wire-based Joule printing, laser-engineered net shaping, laser cladding, and hybrid systems.

The other method included in the direct energy deposition is blown power technology, unlike other metal AM methods, which depend on the power bed. In this method, metal powder and laser are targeted on the print bed to develop highly accurate parts. This method is classified into ten types: laser metal deposition, laser solid forming, direct laser metal deposition, direct laser deposition, direct light fabrication, laser deposition welding, powder fusion welding, directed light fabrication, electron beam direct manufacturing, and direct metal tooling. The main advantage of blown power technology is its high accuracy, reduction in heat-affected zones, and ability to fix with the robotic arms.

Binder Jetting

Binder jetting is used to print resins with metal particles that range from micro-scale. In this process, an industrial printhead selectively deposits a liquid binding agent onto a thin layer of powder particles. It is used for stainless steel, Inconel, and aluminum alloy-based photopolymers.

Material Jetting

Material Jetting (MJ) is the process in which droplets of build and support materials are selectively jetted onto the build platform and cured by either ultraviolet light or heat to form a 3D object. The method is used for nano-scale metal AM and provides a high level of surface finish. The main limitation of this method is that it is limited to the small size of the printed part and the mechanical properties are limited.

Other new technologies out of the scope of the classic ASTM categorization of Additive Manufacturing:

Additive Friction Stir Energy Deposition

This process is similar to the forging process in which metal feed at elevated temperature undergoes a physical deformation to achieve desired shape and size. Compared to other metal AM methods, this method eliminates the need to change metal into a liquid state. The method is yet under development and not yet used widely in industrial application.

Liquid Metal Printing

As per the definition of ASTM, liquid metal printing is defined as a "process in which droplets of build material are selectively deposited" onto a substrate. The main benefits of the liquid metal printing is that non-weldable metals can also be 3D printed using this technology and do not require high power lasers.

Landscape Of the Metal AM

The following table summarizes the landscape of the metal AM and classifies the companies (not exhaustive) based upon the technology in which the metal AM companies are engaged.

Market Share and analysis of The Various Metal Additive Technologies

Metal AM technology is one of the fastest-growing areas of additive manufacturing and an essential part of Industry 4.0. According to a study, the metal AM market will value USD 7.19 billion and demonstrate a CAGR of 21.94% during 2021-2025. But, the market is affected by the COVID-19 pandemic and the current Russia-Ukraine war. The rise in market uncertainty will affect growth and development and may also slow down due to entropy in the European market.

The primary application of the metal AM parts is the industrial machine sector, which accounts for 20% of the total market share, according to a study published in 2020. The other two sectors are automotive and aerospace, which have 38% of the market. It can be estimated that the rising demand for lightweight alloys and materials is one of the key reasons for such a significant market share. The other sectors include military, medical, architecture, and consumer products. The market share in these sectors is also likely to grow in the coming decade.

Process	Category	Company
Material Extrusion	Fused Deposition Modeling	Ultimaker, Aleph Objects, 3Dgence, XYZ Printing, Desktop Meta, RepRap, Zortrax, Perfect Laser, Builder 3D Printers, RE:3D, Xioneer systems, Tiwari Scientific Instruments, Epeired, Triditive, Metallum 3d, Pollen, Hage 3D, Aim 3D, Xerion, Rapidia, Evo-tech, CLO, Markforged
	Bound Powder Extrusion	Desktop Metal
Powder Bed Fusion	Direct Metal Laser Sintering	3D Systems, Renishaw, Concept Laser (GE Additive), EOS, DMG Mori
	SLM Solutions, Xact Metal,3Dprotofab, Raycham, RAM3D	Arcam (GE Additive), Wayland, Jeol, Freemelt, HBD , AM Pro Innovation, Admatec, Incus, Exaddom, Exone, Probeam, Spee3d, Titomic, Chiron, Romi, Form Alloys, Laster Melting Innovation, Intech Additve Solutions, Addup, Ricoh, Meta-additive, Desktop Metal, Mitsubishi, Hermle, Plasma, 3D hybrid System, Prima additive, open additive, Micromax, Dedibot, Simma, HP, Easymfg, 3DED, Tritone, Relizer, adsol, Meltronic, Aconity, alkimat, aurora labs, Beam, Trumpf, Mazak, Melito, DMGMORI, Laser add,Sugino, Formalloy, Iberia, Hybrid Manufacturing, Headmade materials, Wayland Additive, Sailong metal beam, Amoera, E-plus 3D, Alphalaser, BLT, Tangta, Vancantech, Ermaksan, CTC
	Selective Laser Melting	
	Electron Beam Melting	
	Direct Metal Laser Melting	
	Metal Lithography	
	Mould Surry Deposition	
	Area wise Metal Laser Beam Power Fusion	
	Cold spray	
	Powder Spray Laser Energy Deposition	

Directed Energy Deposition	Electron Beam Additive Manufacturing	Spee3D Prodways, Gefertec, Glenalmond Technologies, Norsk Titanium AS
	Wire Arc Additive Manufacturing	Additec, Formalloy, InssTek, Digital Alloys Laser Cladding Technologies, Laserline, Preconic
	Laser Metal Deposition	Ambit Technology, Mazak, ELB, BFW Technologies, Probeam, DMAMS, Evocam, Sciaky, Xbeam, MX3D, Lincoln Electric, ProCada, Chiron, Precitec, 3d hybrid solution, Melito, SBI additive, WAAM, ADDILAN, AML3D, Frronius
	Wire-based Joule printing Digital Alloys Technology	
	Laser Consolidation Additive Manufacturing	
	Wire Plasma Arc Energy Deposition	
Material Jetting	NanoParticle Jetting	Xjet, nanogrande
Binder Jetting	Binder Jetting Hybrid Binder Jetting	Desktop Metal, ExOne, Digital Metal, HP
Additive Friction Stir Energy Deposition	Additive Friction Stir Energy Deposition	MELD, Weisser
Liquid Metal Printing	Liquid Metal Printing	Xerox, Grob, ValCUN

Based on the methods, the powder bed fusion technology owns a significant market share. The technique is widely used to develop industrial components based upon metal AM. Additionally, the majority of companies trade in powder bed fusion technology. The other significant market share method is material binder jetting and direct energy deposition. Both of the processes combined have a market share of 32%. Other methods such as material extrusion, VAT Photopolymerization, lamination also share market share in industrial metal AM.

Conclusions

To summarize, the business of metal AM is constantly growing, and new technologies as per needs of the industry are being developed with support from research and development activities. The next few years will be interesting to see how Metal Additive Manufacturing technologies overcome existing industrial challenges and increase cost effectiveness and reliability.

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AM NEWS

Agnikul Cosmos inaugurates facility to 3D print rocket engines at scale

The IIT-Madras incubated start-up is on of the first in the world to design a rocket engine that can be 3D printed as a single piece of hardware using Metal Additive Manufacturing.

More from the News

Chennai-based space-tech start-up Agnikul Cosmos opened its Rocket Factory-1 — India's first-ever rocket facility dedicated to 3D printed rocket engines at scale. According to a press release, the facility at IIT Madras Research Park was unveiled by N Chandrasekaran, Chairman, TATA Sons with ISRO Chairman S Somanath being the Guest of Honour.

A facility unlike any other, Agnikul's Rocket Factory-1 is a production house with varied machineries, including a 400mm x 400mm x 400mm metal 3D printer from EOS, and a host of other machines that will enable end-to-end manufacturing of a rocket engine under one roof. The factory has also been designed keeping in mind the ability to produce two rocket engines per week

Agnikul had entered into an agreement with EOS in 2021 as their 3D printing partner for engines and this is an important step in seeing that support translate to reality, the release said.

The IIT Madras incubated start-up became the first Indian company to sign an agreement with the Indian Space Research Organisation (ISRO) in December 2020. The agreement signed under the IN-SPACe initiative sanctioned Agnikul to access the Indian space agency's expertise and facilities to build Agnibaan.

Agnibaan's features

Agnibaan is a customisable, two-stage launch vehicle, capable of taking up to 100 kg payload to orbit around 700 km high (low Earth orbits) and enable plug-and-play configuration. It is the world's first single-piece 3D printed engine fully designed and manufactured in India and was successfully test-fired in early 2021. Agnikul showcased this engine at IAC 2021, the space tech gathering held in Dubai

Srinath Ravichandran, Co-founder & CEO, Agnikul said, "This marks the beginning of a new phase where we step into scaling and production from R&D & testing. I am immensely proud of our team and grateful for their zeal and commitment to translating translate our vision into reality."

Founded in 2017, Agnikul's mission is to make space accessible and affordable and has its eyes set on supporting Prime Minister Narendra Modi's vision of

enabling the building of Aatmanirbhar Bharat. "Agnikul has raised total funding of ₹105 crore from Mayfield India, pi Ventures, Speciale Invest, and a host of others including prominent angels such as Anand Mahindra and Naval Ravikant since 2019," the release said.

VIT–SEDAXIS Centre of Excellence for Additive Manufacturing – INAUGURATION

VIT–SEDAXIS Centre of Excellence for Additive Manufacturing inaugurated to support training, start-ups and research.

Honorable Chancellor, Dr. G. Viswanathan, and The Chief Guest, Mr. Hans Raj Verma, Chairman and Managing Director, The Tamilnadu Industrial Investment Corporation, Chennai along with other prominent industry representatives formally launched the inauguration function by lighting the lamp.

More from the News

Additive manufacturing (AM) is the answer towards promoting sustainability in the digital manufacturing era of Industry 4.0. AM reduces the number of steps in the manufacturing workflow with minimal material wastage and helps in reduction of carbon footprint. AM gives the engineers numerous degrees of freedom in design and manufacturing, and thus can bring unique products faster to the market. The Indian government has recently published its Additive Manufacturing Policy that enhances the adoption AM technologies by Indian MSMEs to support Make in India.

Nearly 10 months after the signing of a MoU to help make AM more mainstream amongst the Academic, R&D and SME/Start-up communities, the VIT-SEDAXIS Centre of Excellence for Additive Manufacturing was formally inaugurated on July 20th , 2022 amidst the enthusiastic participation of delegates from Academia/R&D, Industry and Government. The Centre is the result of a first-of-its-kind collaboration between a prestigious academic institution in India, Vellore Institute of Technology (Chennai) and their Industry Partner and AM Solutions/Services provider, Sedaxis Advanced Materials Pvt. Ltd. It is located inside the VIT Chennai campus situated on Vandalur-Kelambakkam Road, Chennai.

The Centre was inaugurated by VIT Chancellor Dr. G. Viswanathan, while the Pro-Vice Chancellor Dr. V. Kanchana Bhaaskaran VIT Chennai delivered the welcome address. Mr. Vishwanath Godavarty, Business Head, SEDAXIS Advanced Materials Pvt. Ltd. briefed the audience about Vision & Mission of the Centre and elaborated on its state-of-the-art facilities. He also detailed on how the Centre's objectives were beautifully aligned with the strategy outcomes as envisaged in the National Strategy for Additive Manufacturing laid out by the Govt. of India in Feb. 2022.

The Chief Guest Mr. Hans Raj Verma, Chairman & Managing Director, The Tamilnadu Industrial Investment Corporation, Chennai., indicated the current economic situation and the responsibility of the society to revive the industrial sector and congratulated SEDAXIS for bringing out a Centre of Excellence in Chennai and appreciated VIT Chennai for incepting a Centre towards achieving this goal. He also inaugurated the Panel Discussion on Industry Academic Ecosystem to support the National Strategy for Additive Manufacturing Policy and Make in India. The panel members who represented federal, industrial as well as academic views included:

1) Dr. Sreenivas Rao, Outstanding Scientist & Director, Naval Science and Technological Laboratory, DRDO, Vishakapatnam,
2) Mr. Sivarajah, Mission Director and CEO, Tamil Nadu

Startup and Innovation Mission,
3) Dr. Nikhil S Tambe, CEO, Energy Consortium, IIT Madras,
4) Dr. Devendran, Managing Director, ST Advanced Composites, Chennai and
5) Mr. Vishwanath Godavarty, Business Head, SEDAXIS Advanced Materials Pvt. Ltd.

The members discussed the status of the 3D printing movement in India, applications, current research trends in the nation and emphasised the need for scaling up the reach of 3D printers even to remote locations of India. Mr. Vishwanath Godavarty from SEDAXIS urged the State Govt. of Tamil Nadu to join the partnership with VIT and SEDAXIS to generate mass awareness and promote mass adoption of 3D Printing amongst the MSMEs in TamilNadu.

Following the panel discussion, VIT's Chancellor and former Member of Parliament, Dr. G Viswanathan opened the Centre in the presence of all dignitaries. This was followed by a tour of the Centre and its facilities by Mr. Vishwanath Godavarty, SEDAXIS Business Head. One of the biggest USPs of the Centre is in its ability to provide low-cost access to skill building, research and manufacturing to the three key stakeholder communities for 3D Printing – Students, Researchers and SMEs/Start-ups. The Centre will conduct a series of workshops with a core theoretical element supported by a mandatory hands-on training element to stakeholders from industry and academia. The Centre also claims to be the most affordable in the region for students and SMEs to avail design, engineering and manufacturing services from. For researchers, the Centre boasts of an array of 3d printers all using open materials and some allowing for complete control of parameters governing the 3D Printing process, thus enabling active and unhindered research for the burgeoning R&D community in India. The Centre with a full-time resident manpower of experts from design, engineering and production/post-processing has already begun supporting Doctoral Research students from within VIT, Chennai on their research projects. The Centre has also undertaken projects with leading institutions like IITs, NITs and IISc to showcase the potential of select hardware and software infrastructure within the Centre to support their research needs. The Centre will also feature prominently in VIT Chennai's rich industry outreach initiatives wherein VITs current and future industry partners will be able to avail of the Centre's AM resources for industry projects and services. The establishment of the VIT-SEDAXIS CoE for AM, the first-of-its-kind in the nation, sets a benchmark for the realization of Additive Manufacturing's true potential and benefit when academia and industry choose to come together to accelerate the awareness and adoption of Digital Manufacturing in India.

AM Ventures to support industrial 3d printing with new fund infusion of USD 100 M

AM Ventures have recently closed a $100 million fund focusing specifically on commercial 3D printing and industrial start-ups. AM Ventures have an portfolio 15 companies that includes Vectoflow, Conflux Technology, Lightforce, Additive Drives, Lithoz, DyeMansion, Cubicure, Sintratec, Incus, Exmet, Elementum, Spectroplast, 3YOURMIND, Additive Work, MetShape, Headmade Materials and Scrona.

More from the News

"The additive manufacturing industry has shown steady and strong growth over the last decade and startups have played a crucial role during this time," Arno Held, co-founder and managing partner at AM Ventures said

in his statement. "The additive manufacturing industry has shown steady and strong growth over the last decade and startups have played a crucial role during this time," Arno Held, co-founder and managing partner at AM Ventures, said in a statement. "We are convinced that startups will continue to be key in providing the innovation required to finally bring the digital world to the real world, and that they will help produce industrial goods in a sustainable manner and thus strengthen supply chains and tackle climate change."

"The fact that portfolio company founders are now investing in our fund is great validation of our exceptional effort. We are proud of the high-level commitment and trust from prime investors that support us on our mission to leading sustainable additive revolutions," Johann Oberhofer, co-founder and managing partner at AM Ventures.

The fund by AM Ventures will be investment into four categories that mainly includes AM hardware, AM software, new materials, and advance applications.

About AM Ventures

AM Ventures is a venture capital firm investing in additive manufacturing startups. The firm provides an ecosystem of sustainable investments in hardware, software, materials, and applications start-ups. It also offers customized investments and provides startups with unique access to advanced production technologies. They also introduce entrepreneurs to a pool of industry experts, each one with decades of experience in engineering, production, or executive management.

Markforged to Expand into Mass Production of End-Use Metal Parts Through Digital Metal Acquisition

Markforged, creator of the integrated metal and carbon fiber additive manufacturing platform, The Digital Forge, today announced that it has entered into a definitive agreement with Höganäs AB to acquire Digital Metal, the creator of a leading binder jetting solution known to be precise and reliable, extending Markforged's capabilities into high-throughput production of metal additive parts.

The addition of Digital Metal furthers Markforged's strategy to solve manufacturing challenges for industrial customers at the point of need. With this new offering, manufacturers have the opportunity to produce high volumes of functional metal parts with minimal setup required. Traditional production often requires months to move from design to manufacturing, introduces third party supplier risk, and provides poor unit economics during ramp up and in lower volumes.

Markforged sees powder binder jetting as a highly scalable additive manufacturing technology for production grade parts using a variety of metal materials. Digital Metal's solution is designed to provide high-precision, best-in-class part quality and reliability. Powder binder jetting complements the existing Digital Forge offering, and will expand Markforged's addressable market by solving new customer problems.

"With the Digital Metal acquisition, Markforged is advancing our vision for distributed manufacturing by enabling the reliable, high volume production of precise metal parts at the point of need. Infusing Digital Metal's solution into The Digital Forge platform allows us to address new applications in the medical, automotive, luxury goods and other industries," said Shai Terem, president and CEO of Markforged. "The Digital Metal

team has created a robust and scalable solution that complements our existing technologies. I look forward to welcoming their talented people to Markforged."

Founded in 2003, Digital Metal is a wholly-owned subsidiary of Höganäs AB and the creator of a proprietary binder jetting AM technology. Known for high productivity, excellent surface quality and superior resolution, Digital Metal printers have been used to produce hundreds of thousands of parts, including parts for leaders in consumer products, academia, and the automotive industry. Markforged sees significant opportunities to further accelerate Digital Metal adoption through integrated software capabilities and a global go-to-market engine.

"Markforged's easy-to-use platform, best-in-class software capabilities and material expertise felt like a natural fit for the future of our technology," said Christian Lönne, CEO of Digital Metal. "With Markforged's experience and go-to-market scale, we are confident that we will be able to grow our technology together and help more manufacturers produce the high-volume metal parts they need to drive highly productive and cost efficient operations."

As part of the transaction, Markforged will pay Höganäs approximately $32 million in cash, approximately 4.1 million shares of Markforged common stock and approximately $1.5 million in cash to settle certain intercompany balances, subject to certain adjustments. The acquisition of Digital Metal is expected to close during the third quarter of 2022, subject to customary conditions.

EOS announced addition of four more metals to 3D printing materials

EOS has announced the addition of four new metal additive manufacturing materials to its EOS M 290 portfolio.

More from the News

The materials include EOS StainlessSteel 254,

Aerospike nozzle built in EOS NickelAlloy HAYNES 282 (Credit: EOS)

StainlessSteel SuperDuplex, ToolSteel CM55, and NickelAlloy HAYNES 282 and are all said to meet the 3D printing company's Technology Readiness Level (TRL) 3 Core classification, meaning they're categorised as under development and available to early access customers.

Sascha Rudolph, SVP BU Metal Materials at EOS said: "Material development is always driven by customer demand and very often is the result of a close customer cooperation. These four new metal materials were designed and optimised specifically to the needs of additive manufacturing. We are increasing application opportunities for demanding industries by bringing AM tailored alloys to our customers."

The first, EOS StainlessSteel 254 is an austenitic stainless steel that comes with a 40/60 m process for the EOS M 290 and is said to be suited for applications such as chlorinated seawater handling equipment, pulp, and paper manufacturing devices as well as chemical handling equipment due to its high chromium, molybdenum and nitrogen alloying providing corrosion resistance in difficult environments. The material also has provides excellent stress corrosion cracking and higher strength than conventional austenitic steel, and excellent resistance to uniform, pitting and crevice corrosion.

For tougher environments, EOS StainlessSteel SuperDuplex is an austenitic-ferritic duplex stainless

steel optimised for AM and comes with a 40/80 m process for the EOS M 290. Its high chromium, molybdenum and nitrogen alloying provide excellent corrosion resistance in difficult environments, particularly for applications in oil and gas, in pulp and paper manufacturing devices and for mining and offshore equipment, and shows excellent resistance to uniform, pitting and crevice corrosion, as well as enabling high strength together with high corrosion resistance.

For more demanding applications in elevated temperatures, EOS ToolSteel CM55 is a cobalt-free, ultra-high strength, and high hardness steel for tooling and engineering applications such as cold and hot working tools, powertrain components and mechanical engineering components. The material comes with a 40/80 m process for the EOS M 290.

Lastly, EOS NickelAlloy HAYNES 282 has been developed for high temperature structural applications in aerospace and energy markets including turbomachinery and rocket engine components. The material, a precipitation strengthened nickel-based superalloy with a unique combination of high temperature strength, thermal stability, good corrosion, and oxidation resistance, and excellent weldability, is being manufactured under license from Haynes International Inc. and is intended for use on EOS metal systems.

AWI targets new additive manufacturing opportunities at Farnborough International Airshow

Alloy Wire International (AWI), which has been AS9100-accredited since 2013, is now selling its Exotic nickel alloy wire to the 3D printing industry as more suppliers tap into the desire for cost effective rapid production of parts.

More from the News

The company can manufacture its wire for 'Wire Arc Additive Manufacturing (WAAM)', a process that produces near net shape components that require less machining and wastes less material than conventional methods.

AWI is heading to Farnborough International Airshow next week (July 18-22) with an exciting new offer for component makers. Pic credit: Dan Graves.

It can also provide quicker lead times than conventional forging or casting without the need for complex tooling, moulds or dies.

Angus Hogarth, R&D Director at AWI, commented: "It's all about finding that manufacturing difference and additive manufacturing is a discipline the aerospace manufacturers are increasingly investing in.

"We were confident we could play a role in 3D Printing and, after months of R&D and technical reviews, we see our business as being a strong supplier of Exotic nickel alloy wire to the growing additive manufacturing sector. This is something we will definitely be promoting at Farnborough with new and existing customers.

Exhibiting as part of the Midlands Aerospace Alliance cluster in Hall 1 (Pod 1, Stand 1320), Alloy Wire International tends to be a 4th tier supplier to the aerospace market, with its material manufactured into components that are integral to aircraft structures, in instrumentation and high-performance engines.

The company's wire and straight bars, which are

produced at its state-of-the-art factory in the West Midlands, is made into springs, fire detection wire, fasteners and electrical instruments – all manufactured so that they work at high temperatures and/or in corrosive gases or liquids.

Visitors to the show will get the opportunity to talk with AWI's R&D and sales personnel to discuss new projects, prototype work and supply chain agility, with orders able to be made in coils, on spools or straight bars within a range of 0.025mm (0.001") to 21mm (0.827").

Paul Chatterley, Sales Executive at Alloy Wire International, went on to add: "We'll be displaying some commonly used alloys for the aerospace sector, including Inconel, Nimonic, Monel, Nitronic, Phynox and Waspaloy.

"For only the second time, delegates will also be able to explore the recent introduction of INCONEL: 617®, a Nickel-Chromium-Cobalt-Molybdenum alloy with an addition of aluminium.

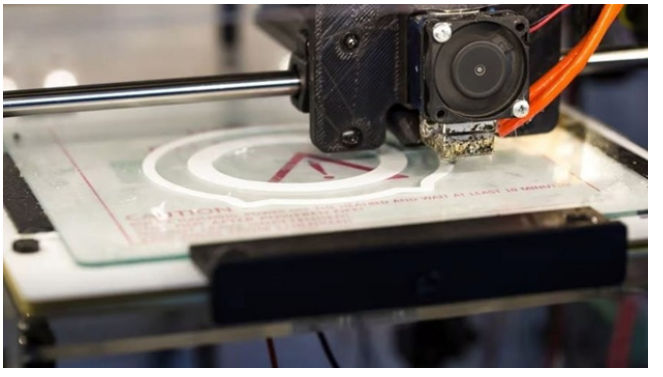
"This is our latest addition to a 60+ range of alloys and delivers a combination of increased strength and stability at elevated temperatures (up to 1100°C/2012°F), whilst retaining the high temperature resistance of INCONEL® alloy 601.

"Its high Nickel and Chromium content makes INCONEL: 617® resistant to a variety of both reducing and oxidising media, not to mention achieving comparable corrosion resistance to INCONEL 625."

AWI is a long-standing member of the Midlands Aerospace Alliance and, with export levels approaching 65% of its £12m turnover, will be one of the firms chosen to meet Mr Ranil Jayawardena, Minister for International Trade, on Tuesday 19 July.

FDA seeks input on regulating 3D-printed implants, devices made at the point of care

The FDA has begun outlining a potential approach for regulating a cutting-edge front emerging in healthcare: the 3D printing of medical implants or devices customized for each individual patient and manufactured on-site and on-demand within hospitals or doctor's offices.



Generally, the FDA said, a point-of-care 3D-printing facility located within a hospital would not be considered a manufacturer by itself, but some exceptions may occur. (Pixabay)

More from the News

This technology could one day provide specific spine implants designed to fit perfectly among a particular patient's vertebrae or quickly build accurate, physical models that surgeons could use to help plan out and rehearse a risky procedure, according to the agency.

Starting with a published discussion paper, the FDA is now collecting comments from the medtech industry and the public to help inform future guidance documents. The agency is seeking input on which of today's regulations, aimed at so-called traditional device manufacturers, would be easy or difficult for 3D-printed devices to satisfy, among other topics.

"The 3D printing of medical devices is at the forefront of innovation and healthcare," the FDA's William Maisel and Ed Margerrison, directors of the Office of Product Evaluation and Quality and the Office of Science and Engineering Laboratories, respectively, said in an agency statement.

"The discussion paper we're sharing today provides

insight into our perspective of the benefits and challenges of 3D printing at hospitals and other points of care and presents a potential approach for regulatory oversight under various scenarios to inform future policy development," Maisel and Margerrison added.

"This feedback will help build the foundation for an appropriate regulatory approach for 3D printing at the point of care, personalized care for patients and new innovations in this area," they said. The FDA previously issued guidance on 3D-printed products manufactured outside the point of care in December 2017.

The new discussion paper outlines a number of future scenarios—such as a hospital maintaining its own medical device production system. Generally, the FDA said, a point-of-care 3D-printing facility would not be considered a manufacturer by itself if the company demonstrates that multiple raw materials, scanners or printers could consistently produce high-quality devices.

However, some exceptions to that rule may occur if certain post-processing actions are taken within the hospital, such as machining, drilling or sterilization steps that may affect a product's safety or effectiveness.

Other examples include 3D-printing facilities maintained by the company near the healthcare provider to produce patient-matched titanium implants or specially designed prostheses. Between both settings, certain regulatory responsibilities would have to lie with the company, and others with the healthcare facility, the agency said.

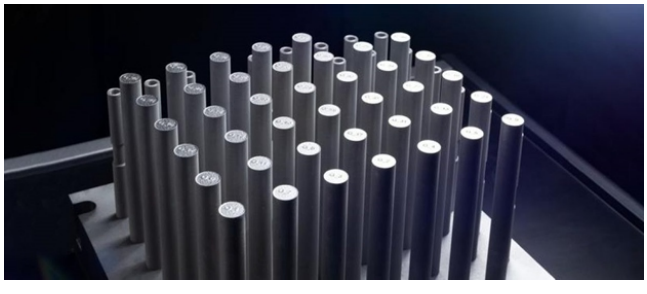
The FDA is also asking for feedback on which types of 3D-printed devices would produce the lowest risk to the patient and what regulatory flexibility the agency could provide in that space. Submissions are being collected through February 8, 2022.

In addition, the agency is looking to learn how 3D printing has been employed over the course of the COVID-19 pandemic, including new situations and product shortages where users may not have had all the information they needed.

In March 2020, as the demand for critical medical hardware began to outpace supplies worldwide, 3D printers were seen as a way to quickly produce scarce ventilator valves and other parts, as well as personal protective equipment such as face masks and rigid plastic shields.

The FDA began working with a range of public and private organizations to evaluate and distribute 3D designs and models alongside the National Institutes of Health, the Department of Veterans Affairs and America Makes, the national accelerator program for additive manufacturing managed by the Department of Defense.

EU project InShaPe – Next innovation leap in metal-based additive manufacturing



The research and innovation project InShaPe, funded by the EU with EUR 6.8 million, aims to make a decisive contribution to the further development of metal additive manufacturing technology. Under the coordination of the Technical University of Munich (TUM), here the Professorship of Laser-based Additive Manufacturing, ten partners from seven countries are working together on the project.

More from the News

In many industrial sectors, such as in the automotive industry, in aerospace or in the energy sector, the demand for special metal components that are light

and have a high strength is increasing. Modern gas turbines, for example, require extremely stable and at the same time lightweight heat shields. An important manufacturing process for this is the powder-bed fusion process of metals using laser beam (PBF-LB/M). Depending on the application, the process is not yet always competitive compared with conventional production in terms of unit costs.

The research and innovation project InShaPe, funded by the EU with EUR 6.8 million, aims to make a decisive contribution to the further development of the technology. Under the coordination of the Technical University of Munich (TUM), here the Professorship of Laser-based Additive Manufacturing, ten partners from seven countries are working together on the project.

In powder-bed fusion of metals, extremely thin layers of metal powder are applied to a building platform. This powder layer is melted by a focused laser beam and binds to the underlying material layer during solidification. This process is repeated layer by layer until a finished component is created. Due to the layered structure, complex and weight-saving geometries can be realised. After removal of excess powder, the finished component is then usually post-processed depending on the application.

Flexible adaptation of the laser spot enables efficient and cost-effective production

The aim of the recently launched EU project InShaPe is to further develop metal-based additive manufacturing. The improved manufacturing process is based on a high-performance optical module with programmable intensity distribution and AI techniques to determine the optimal beam shape for the target object, determined for example by the material type and geometry. InShaPe also develops an innovative process monitoring and control system for quality analysis that integrates multispectral imaging, i.e. simultaneous observation of light of different wavelengths into the area of additive manufacturing.

“The combination of these two new technologies enables efficient and advanced exposure strategies so that even the most demanding production of complex special components works right away”, says InShaPe coordinator Prof. Dr.-Ing. Katrin Wudy from the School of Engineering and Design at the Technical University of Munich.

InShaPe makes metal-based additive manufacturing faster, cheaper and more sustainable

The consortium has set itself the goal of further developing this form of additive manufacturing into a commercially wide-ranging manufacturing technology that shall outperform conventional manufacturing processes such as die casting in terms of precision and sustainability in the future. This is due to the fact that the adaptation of the laser beam shape and the new exposure options enable an energy- and material-efficient production process. At the same time, the InShaPe innovation aims at demonstrating the competitiveness of additive manufacturing compared to traditional manufacturing processes in terms of unit costs, flexibility and production volume. The AI-supported control and operation should also enable non-highly qualified workers to use the new process.

The overall goal of InShaPe is to further develop and demonstrate an innovative powder-bed fusion process for metals (PBF-LB/M) for four industrial applications in the aerospace, energy and automotive industry. Compared to the current state of the art, the following advantages should be achieved:

- a seven times higher production rate
- over 50 percent lower costs
- 60 percent less energy consumption
- 30 percent less waste

In the long term, the successful development and marketing of InShaPe technologies is intended to strengthen the European PBF-LB/M manufacturing industry as a leading provider of highly complex parts and set new best-in-class standards for digital, resource-efficient and agile laser-based production methods.

Sigma Additive Solutions Announces Amace Solutions has Joined its OEM Partner Network

Sigma Additive Solutions (NASDAQ:SASI) ("Sigma"), a leading developer of quality assurance software to the commercial 3D printing industry, has announced in collaboration with Sigma's partner in India, Excel3D, Amace Solutions Pvt. Ltd. has agreed to join the Sigma OEM Partner Network. Amace is the 3D Printing arm of Ace Micromatic Group (AMG), the largest machine tool conglomerate in India.

More from the News

As an OEM Partner, Amace will integrate Sigma's PrintRite3D® monitoring and analytics technology into its STLR® Series of production-ready machines in order to support its customers with real-time quality monitoring and analytics. The agreement starts with multi-unit sales to support both internal future development and customer deployment. The Sigma and Amace engineering teams will work closely together to build initial workflows around qualification of parts and create a knowledge base of materials, processes and best practices.

Jacob Brunsberg, President and CEO of Sigma Additive Solutions, stated, "Coming out of the largest machine tool conglomerate in India, Amace is a quality addition to the Sigma OEM network family. We have a great deal of respect for their approach to technology and additive production. Most important, the team at Amace shares our passion to improve machine, process and part health, while enabling cost-effective, high-volume production. The fact that Amace utilizes the Materialise Control Platform (MCP) is also a plus given our recent announcement that we are working with Materialise to allow users to identify and correct metal build issues in real-time via a closed-loop control process."

Added Dr. Vishwas R. Puttige, Amace Solutions head of business, "Sigma is the industry leader in additive manufacturing quality monitoring and analytics. We anticipate future success in offering a combined solution that will benefit key industries like aerospace, defense, medical, industrial, and automotive. We look forward to partnering with the Sigma team to accelerate additive manufacturing production scalability."

Pratt & Whitney Evaluating an End-to-end Solution from Velo3D to Manufacture Production Jet Engine Components

Velo3D, Inc. (NYSE: VLD), a leading metal additive

manufacturing technology company for mission-critical parts, today announced that Pratt & Whitney, a Raytheon Technologies business, has acquired an end-to-end solution from Velo3D to evaluate the Sapphire printer for manufacturing production jet engine components.

More from the News

This is the first Sapphire printer to be located at Pratt & Whitney; it previously utilized Velo3D's contract manufacturer network to produce printed and finished parts.

"Pratt & Whitney looks forward to future applications using the Sapphire XC printer, and collaborations with other potential suppliers with the Velo3D capability, for Pratt & Whitney GTF™ and advanced engine programs"

Pratt & Whitney and Raytheon Technologies are experienced and accomplished users of Additive Manufacturing (AM) technologies with extensive knowledge across various platforms and applications. Raytheon Technologies is a launch participant of President Biden's AM Forward initiative, a new program encouraging companies to explore the use of additive manufacturing to transform supply chains and drive innovation. Raytheon Technologies' commitment includes seeking small-medium-enterprise manufacturers' involvement in over 50% of its requests for quotes on products manufactured using additive technologies, as well as seeking to simplify and accelerate the procurement process of AM parts.

"Metal additive manufacturing can transform aviation and space systems by delivering unprecedented part consolidation, lighter weight components, and more efficient systems," said Benny Buller, Velo3D Founder and CEO. "We're pleased to see Pratt & Whitney move forward with their own Sapphire XC printer. We're eager to see how they innovate their most mission critical designs using the end-to-end solution and how the economies of scale of an in-house system help increase addressable use-cases."

"Pratt & Whitney looks forward to future applications using the Sapphire XC printer, and collaborations with other potential suppliers with the Velo3D capability, for Pratt & Whitney GTF™ and advanced engine programs," said Jesse Boyer, fellow, Additive Manufacturing, Pratt & Whitney.

The company's new Sapphire XC printer is calibrated to print in Inconel 718, a nickel-based superalloy well-suited for extreme temperatures.

The Raytheon Technologies Research Center is the company's central innovation hub where engineers, scientists and researchers explore and develop new, transformative technologies. The center provides the company's businesses with groundbreaking innovations and solutions to critical customer problems in a wide range of research areas, including complex integrated systems, advanced materials and manufacturing, autonomy-enabling technologies, electrification, and sustainability.

This is made possible by Velo3D's end-to-end solution, which includes Flow print preparation software, the Sapphire family of printers, Assure quality assurance software, and Intelligent Fusion underlying manufacturing processes. The system uses a set of known recipes to achieve the geometries desired without using supports and monitors the build process layer-by-layer to ensure the highest quality.

AMEXCI Oy invests in Additive Manufacturing machine from AMCM GmbH

AMEXCI OY, the Finish subsidiary of AMEXCI established in 2021, has invested in its first Additive Manufacturing machine, an AMCM M 290-2 from AMCM GmbH, an EOS Group company. The Laser Beam Powder Bed Fusion (PBF-LB) machine will be installed at AMEXCI's newly-built Additive Manufacturing lab in Tampere, Finland.

More from the News

The company explains that its investment in the new

AMEXCI OY has invested in an AMCM M 290-2 from AMCM GmbH, an EOS Group company (Courtesy AMCM GmbH)

AM machine is essential in AMEXCI's goal of connecting the Nordics, allowing the company to provide higher quality services and products to customers locally in Finland. AMEXCI states that it is already supporting its customers to develop business cases, designing for AM and this investment will also enable localised production of parts.

Additive Manufacturing in Finland has reportedly matured in previous years, and AMEXCI OY already works closely with its Finnish shareholders, Wärtsilä and Stora Enso. AMEXCI's strategic presence in both Sweden and Finland aims to strengthen the collaboration between shareholders, partners and customers in Finland, creating an Additive Manufacturing hub for continuous development in metal AM.

"We are excited to have our first industrial 3D printing system in production by Q3," stated Johannes Karjalainen, Managing Director, AMEXCI OY. "Our lab in Tampere is constructed according to highest industry standards and responds to the demands for high-quality AM parts and safe AM environments. This acquisition allows us to push metal AM forward across the Baltic Sea and the rest of the Nordics."

AMXECI explains that compared to the EOS M 290, the AMCM M 290-2 has two 400-watt lasers providing AMEXCI customers with EOS M 290 technology while almost doubling the productivity and reducing customers' cost per part. Additionally, the AM machine comes with Optical Tomography (OT), which provides users with data from the Additive Manufacturing process, containing quality indicators based on the specific requirements for each build.

Markus Glasser, SVP EMEA at EOS, commented, "Both EOS and AMEXCI believe in AM facilitating unique applications, and AMEXCI is the perfect end-to-end solution partner for us. Beyond the system installation, EOS Oy will co-operate with AMEXCI Oy to further push innovation in metal AM and develop new materials and parameter sets for our technology."

KOKONI Announces Launch of World's 1st 3D Printer With Instant AI 3D Modeling

KOKONI, a cutting-edge company focusing on connecting the virtual world and the real world with innovative 3D printing solutions, announced the launch of an impressive AI 3D modeling 3D printer.

More form the News

This new device makes it easy and affordable for anyone to create photo-realistic 3D models from 2D images using just their phone and a KOKONI printer. This exciting new printer streamlines the process of 3D avatar modeling for any application and is available soon on Indiegogo. For more information, please visit the video here.

KOKONI unleashes unlimited creativity without the

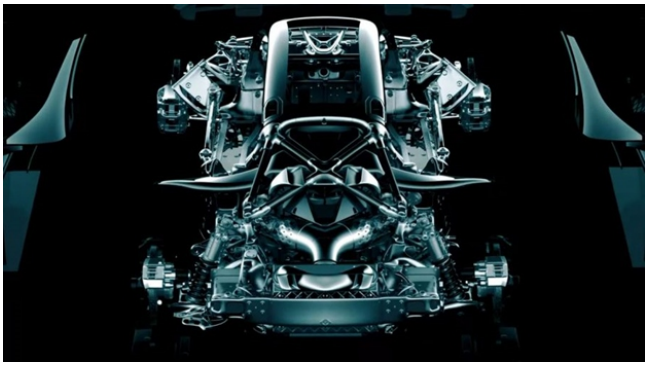
need for expensive scanners, complicated software or prohibitively priced printers. After downloading their exclusive mobile app, users can simply take photos or upload them to generate a 3D model that prints directly in photorealistic detail. With an advanced Smart AI algorithm, KOKONI seamlessly turns 2D images into 3D models like magic. No assembly or complicated setup is needed to get started. KOKONI uses an automatic configuration and a user-friendly design to make it intuitive to use, even for beginners. Its advanced AI algorithm is powerful yet easy to control via app to maximize options for 3D modeling, allowing anyone to transform creativity, inspiration and imagination into reality. Easy to use for all ages, it's the best way to start exploring the world of 3D modeling for beginners, hobbyists, and experts alike.

"As virtual reality becomes a bigger part of our daily lives, we seek ways to make meaningful connections between the virtual and real worlds. The EC-1 is part of that journey, with powerful AI algorithms that make 3D modeling easy for anyone. There is no longer any need to work with complicated modeling software or use expensive equipment. With just a smartphone and the KOKONI EC-1, photorealistic 3D avatars and models come to life at the touch of a button." KOKONI CEO Chen Tianrun.

Equipped with a specially-developed nozzle and exclusive PLA filament, KOKONI creates smoother model surfaces and more decent prints without clogging using finite element thermal simulation. It's quiet and fast, printing at speeds up to 80mm/s. A motherboard with 1.4GHz quad-core processor and self-developed silent driver provides faster processing along with integrated AI motion control algorithm and wireless IoT. The results are astounding and the process of transforming 2D photos into 3D has never been easier.

KOKONI, the world's first 3D Printer with Instant AI 3D Modeling is truly a game-changer, giving everyone the power to create stunning 3D avatars and models with ease. KOKONI is available for pre-sale soon on Indiegogo with rewards and incentives for early adopters. Learn more on the campaign page.

Divergent secures up to $80 million in new funding for 3D-printed cars



Picture: Divergent

Divergent Technologies Inc., a company that developed an end-to-end digital production system to revolutionize industrial-scale manufacturing, announced that it has closed a new $60 million venture loan facility led by Horizon Technology Finance Corporation (NASDAQ: HRZN), and a new $20 million revolving line of credit provided by Bridge Bank, a division of Western Alliance Bank (NYSE: WAL). The new facilities follow Divergent's successful $160 million Series C funding earlier this year.

More from the News

Under the terms of the venture loan agreement, Horizon, a specialty finance company that provides capital in the form of secured loans to venture capital backed companies in the technology, life science, healthcare information and services, and sustainability industries, funded $15 million of the initial draw from the venture loan facility, and a private investment vehicle managed by Horizon Technology Finance Management LLC, Horizon's adviser, funded $5 million. The venture loan facility provides up to an additional $40 million of funding to Divergent upon meeting certain milestones.

Under the terms of the line of credit, Bridge Bank, whose Technology Banking Group provides financing solutions

to venture capital backed technology companies at all stages of their life cycle, established a $20 million line of credit with Divergent who will use the funds for growth and working capital purposes.

Divergent is building a global manufacturing infrastructure platform for the next generation industrial economy, with a current focus on the automotive industry. Its full-stack, state-of-the-art Divergent Adaptive Production System ("DAPS") simultaneously aids in automating design, additive manufacturing and assembling complex vehicle structures. As a result, the DAPS platform significantly reduces development and production timelines, and Divergent has established a world-class pipeline of OEM customers.

"We are pleased to receive support from Horizon and Bridge Bank as we continue to revolutionize complex industrial manufacturing, initially with automobiles and over time with aerospace and defense," said Kevin Czinger, lead inventor, founder and Chief Executive Officer of Divergent. "DAPS makes it possible for the first time for manufacturers to forego the capital-intensive static design system they have been accustomed to for over a century, and utilize a variable cost flexible design system that is significantly more efficient. Through this added efficiency, DAPS radically reduces the impact of manufacturing on the environment, thereby making a meaningful contribution to global sustainability."

"Divergent is changing the game for manufacturing vehicles, with their DAPS end-to-end platform providing manufacturers with unmatched cost savings and flexibility," said Gerald A. Michaud, President of Horizon. "With over 500 patent filings, DAPS is a cutting-edge approach that enables Divergent customers to create new product models much more quickly and efficiently. We are excited to support Divergent's growth and expansion."

"Divergent is radically transforming auto manufacturing economics and environmental impact, and it is exciting to see Divergent deliver a solution that addresses system level challenges," said Mike Lederman, Senior Managing Director in Bridge Bank's Technology Banking Group. "Divergent is rethinking the manufacturing process for the auto industry and we are pleased to help support the company's evolution."
BayCross Capital Group acted as the placement agent on the debt (the securities portion of which was conducted via StillPoint Capital, LLC Member FINRA/SIPC).

Bosch develops first 3D-printed ceramic microreactor

A 3D-printing premiere: together with the Karlsruhe Institute of Technology (KIT) and the chemicals company BASF, Bosch has successfully produced the first-ever 3D-printed microreactor made of technical ceramics. Microreactors are devices for housing chemical reactions. In terms of heat, stability, and corrosion, few materials can withstand the extreme conditions caused by high-temperature chemical reactions. "To control and monitor a chemical reaction, a reactor needs to have hardness, heat resistance, and complex structures inside," says Klaus Prosiegel, sales manager at the Bosch startup Advanced Ceramics, based in southern Germany. "3D-printed technical ceramics bring these excellent properties to the table."

Highlights

- Bosch startup Advanced Ceramics combines technical ceramics with 3D printing
- 3D-printed ceramics meet the highest demands
- Applications for technical ceramics range from

medicine to mobility to the home

Many applications for technical ceramics

The market research company Data Bridge forecasts that the global market for technical ceramics will be worth around 16 billion euros by 2029. This versatile material is in demand in a wide range of industries: in medicine, it is used in bipolar scissors, which can cut tissue and stop bleeding at the same time. Electric current flowing through the two metallic halves of the scissors heats the tissue and seals it. An insulator made of technical ceramics ensures that the two metallic blades do not cause a short circuit when the scissors are closed. This makes surgery faster and safer. In energy technology, the extreme heat resistance and ion conductivity of technical ceramics makes them ideal for use in fuel-cell stacks, among other applications. In mobility, distance sensors that help with parking are also made of technical ceramics. Another area of application is grinders for fully automatic coffee machines. Here, the material's extreme durability and hardness ensures that the grinding effect remains the same over time, with no material abrasion that could affect the taste of the coffee. "We have products on the market in all these areas," Prosiegel says.

Premiere: 3D-printed ceramic reactor

Bosch Advanced Ceramics was well aware that technical ceramics are also very well suited for chemical reactions. "The challenge, however, was to find a process that was capable of producing the complex structures inside a ceramic reactor," Prosiegel says. To solve this task, the startup's ten-strong team combined their company's two core competencies: technical ceramics and 3D printing. "We've successfully employed 3D printing to produce ceramic components that can't be made by conventional means," he says.

BASF is now using this microreactor in basic research, since it allows to monitor chemical reactions under ideal temperature conditions. Furthermore, it requires fewer raw materials and less energy than large reactors. Experts can analyze these small-scale results and extrapolate them for large-scale implementation. "This is just like a chef trying out a new recipe on a small scale first before putting the dish on the menu," Prosiegel says. That is why the next step is to print 10 to 20 more reactors with the same design for BASF. In view of the conceivable further potential applications for technical ceramics in the chemicals sector, Prosiegel sees a bright future ahead: "After all, almost every laboratory crucible is made of technical ceramics," he says. It will be a while before he and his colleagues run out of work.

"We've successfully employed 3D printing to produce ceramic components that can't be made by conventional means."

Klaus Prosiegel, Sales Manager Bosch Advanced Ceramics

Bosch startup platform grow

Bosch Advanced Ceramics is part of grow, Bosch's in-house startup platform. With locations in Europe, the Middle East, Africa, Southeast Asia, India, China, Japan, North America, and South America, grow is the global home for startups within the technology company. Worldwide, the startup platform currently has ten projects in the incubation phase.

SINTX Technologies Acquires Technology Assessment and Transfer, Inc.

SINTX Technologies, Inc. (www.sintx.com) (NASDAQ: SINT) ("SINTX" or the "Company"), an original equipment manufacturer of advanced ceramics, announced the acquisition of Technology Assessment and Transfer, Inc. (TA&T; https://www.techassess.com/), significantly increasing SINTX's capabilities in the aerospace, defense, and biomedical markets.

More from the News

"We are excited to acquire TA&T and take another step towards diversifying and strengthening SINTX," said Dr.

Sonny Bal, President and CEO of SINTX. "TA&T will expand our use of advanced manufacturing technologies and introduce new ceramic material platforms to the SINTX portfolio. We expect the acquisition to bring immediate revenue to SINTX via TA&T's well-established relationships with commercial partners and the U.S. government."

TA&T, based in Maryland, is a nearly 40-year-old advanced ceramics business that specializes in developing and commercializing a broad array of innovative materials for defense, biomedical, and industrial applications. The company's technologies and products include 3D printing of ceramic medical devices and heat exchangers, chemical vapor infiltration and deposition of complex fiber-reinforced ceramic-matrix composites, and hot pressing of transparent armor and other technical ceramics. TA&T has a long track record of successfully winning research contracts and grants from the U.S. government and commercializing its innovative technologies.

The Acquisition Broadens Opportunities for SINTX in Aerospace, Defense, and Biomedical Markets

As an example of TA&T's innovation, ceramic heater bodies developed, designed, and manufactured by TA&T are a part of the Sample Analysis on Mars (SAM) instrument suite on board the Curiosity Rover (https://mars.nasa.gov/msl/home/). These oven heater bodies were manufactured by TA&T using Ceramic Stereolithography, a form of 3D printing and additive manufacturing, and can withstand the extreme temperatures of more than 1,500°F that are required to heat soil samples on Mars in hopes of detecting signs of life. TA&T was selected by NASA to make these parts because of the prohibitive cost of traditional manufacturing techniques.

"Technology Assessment and Transfer is excited about the opportunity that the SINTX acquisition provides for product growth in commercial, aerospace, and medical applications," said Dr. Larry Fehrenbacher, Co-Founder and President of TA&T. "The blend of federally-funded innovative technologies and SINTX's business acumen is a compelling synergistic formula for future success."

Dr. Mark Patterson, who worked with TA&T previously, and is currently Principal Scientist at Kratos SRE, commented that "In my view, the acquisition of TA&T by SINTX represents a significant opportunity to leverage complementary cultures and capabilities in the areas of advanced ceramics and innovation. TA&T has a long history of developing unique processes and ceramic materials for space, defense and commercial markets, and the company was an early developer of additively manufactured ceramic components for new ceramic markets. SINTX has complementary capabilities in biomedical devices and ceramic armor, with access to capital markets and organizational skills that will greatly help to mature and transition these technologies. I am excited to see what will come from this promising synergy, and hope that we will get to experience more ceramic products transitioned to end users".

Ascendiant Capital Markets LLC served as the sole M&A Advisor on the transaction.

Major European Automotive OEM Purchases Two Additional SLM Solutions Systems

SLM Solutions Group AG ("SLM Solutions," "SLM" or the "Company") announced the sale of two more SLM® systems to a major European automotive brand.

The Automotive OEM now has an install base of more than ten in its additive entourage.

More from the News

The brand's fleet now consists of more than ten SLM Solutions systems. It is composed of several SLM®500s as well as SLM®280s. The latest purchases are a nod to the productivity the company gains from the systems and further, solidify the trust between the two companies.

The OEM uses its fleet to produce various metal parts for vehicle production. They are used for multiple activities with the focus being serial production. The global automotive market is expected to grow steadily over the next decade, reaching a volume of around 123 million units in 2030 with the majority of it driven by the shift to electric vehicles which in turn will further accelerate the adoption of additive manufacturing which allows, besides others, lighter builds required by heavy battery packs and better thermal management to extend the lifetime of batteries. According to the AMPOWER Report 2022, metal AM system sales to the auto sector amounted to 76 M Euros in 2021 and is expected to more than quadruple to 308 M Euros by 2026. SLM Solutions' customers are able to meet these demands by deploying a fleet of SLM®500s. Between 2020 and 2021, SLM Solutions sold twice as many SLM®500s reaching an install base of around 150 machines globally printing the most complex applications in automotive.

"This latest sale is a testament to the quality of our systems and our commitment to making our partners realise their visions," comments SLM Solutions CEO, Sam O'Leary. "The productivity and reliability of our systems and the innovation and support of our team make us the go-to with the world's leading automotive OEMs. These are long-lasting relationships forged from trust and close collaboration as much as they are from metal and lasers."

SLM Solutions is known as the market leader for many commercial firsts with a focus on increasing productivity with relentless innovation in multi-laser technology. The first quad-laser metal system on the market, the SLM®500 can integrate lasers independently or in parallel to increase build rates by 90% over twin laser configurations. Machine operator and powder are separated through a closed-loop powder handling strategy with an automated powder sieve and supply. Designed for serial production, the exchangeable build cylinder enables the shortest possible fire to fire times, reducing downtimes of the machine to a minimum. The SLM®500 is the best performing, most efficient system in its class.

Nano Dimension Acquires Admatec and Formatec

Nano Dimension Ltd. (Nasdaq: NNDM, "Nano Dimension" or the "Company"), a leading supplier of Additively Manufactured Electronics ("AME") and multi-

dimensional metal & ceramic Additive Manufacturing ("AM") 3D printers, announced today that it has signed and closed a definitive agreement to acquire Formatec Holding B.V ("Admatec/Formatec"), which includes its two subsidiaries – Admatec Europe B.V. ("Admatec") and Formatec Technical Ceramics B.V. ("Formatec").

More from the News

Admatec/Formatec, based in the Netherlands, are comprised of two complementary businesses operating together, which were part of the U.S.-based Precision Surfacing Solutions. It is a leading developer and manufacturer of additive manufacturing and 3D printing systems for ceramic and metal end-user parts. Its industry-grade systems – powered by digital light processing technology – use materials with superior mechanical, electrical, thermal, biological, and chemical properties to produce an array of parts for medical, jewelry, industrial, and investment casting uses. Admatec/Formatec's industrial production service division is a design-to-production partner for industrial-scale customers via its service bureau platform that combines the advantages of injection molding and additive manufacturing. Both means of production have served as a strategic advantage in working with customers, from early-stage ideas into serial production of end-use parts.

Admatec/Formatec has shown promising financial results under strenuous circumstances of its parent company, indicating that accelerated growth based on its innovative technology can be expected. The business delivered $5.3 million in revenue with a gross margin of 56% in 2021. Nano Dimension has paid a total cash sum of $12.9 million for Admatec/Formatec (net of its cash). By joining Nano Dimension, Nano Dimension believes that Admatec/Formatec are now poised for even greater success within the Industry 4.0 landscape, which Nano Dimension is at the forefront of transforming with its combination of deep learning-based AI, additive manufacturing, materials science, and robotics. This expertise is planned to enable advanced breakthroughs across the Admatec/Formatec set of solutions and expected to drive tremendous competitive edges for customers.

Nano Dimension's go-to-market platform is geared to accelerate and broaden the reach of Admatec/Formatec's products and services to growing markets, particularly in the United States and Europe, where a tailwind of macro trends is driving demand for additive manufacturing (AM) while onshoring and localizing high-mix low-volume manufacturing.

With Admatec/Formatec, Nano Dimension will add two critical aspects to its offering in the AM domain: Materials and new product types. Materials have and will continue to be the bedrock of a successful AM offering. Nano Dimension is already leading in materials science thanks to the breakthroughs in driving additively manufactured electronics with both conductive and dielectric materials. Now, Nano Dimension will also benefit from ceramic and metals – two critical materials for developing applications and end-use parts. To date, Nano Dimension has focused on AME and Micro-AM. As the Company advances, offering new Admatec/Formatec product types will harness the ability for customers to print larger parts – going in size from millimeters to multiple centimeters/inches. This is all further enhanced by the combination of possibilities for Nano Dimension with 3D-Addititve Manufacturing integrated with Metal Injection Molding. Jaco Saurwalt, Chief Operating Officer of Admatec/Formatec, who is joining Nano Dimension as the Head of its Admatec/Formatec Division, commented, "The teams across Admatec and Formatec are excited to become a part of Nano Dimension. We are proud of how we have developed this business and are convinced that we shall be able to expand and accelerate our growth based on our present technology and services. We expect that the combined expertise with Nano Dimension will further establish a leading position in the high-mix-low-volume metal 3D-AM production markets."

Yoav Stern, Chairman and Chief Executive Officer of Nano Dimension, shared, "Admatec/Formatec's scientists, engineers and other team members, all of whom joined Nano Dimension upon closing of this

transaction, are experts and industry veterans in AM 3D-industrial processes. They are going to continue to be led by their present management team." Mr. Stern added, "Admatec/Formatec's products and services expand Nano Dimension's Fabrica Division, adding volume manufacturing capabilities to the high precision micro-mechanical Fabrica 2.0 systems."

"No less important," Mr. Stern concluded, "is our intention to use our deep learning-based artificial intelligence technologies, from our DeepCube acquisition, to become the "robotic brains" for Admatec/Formatec systems. We expect this will improve yield and throughput and drive a more seamless integration with Nano Dimension's Fabrica systems. Admatec/Formatec's machines and services fit the larger picture of Nano Dimension's vision, aiming to establish "Industry 4.0" solutions, which entail building an AI-based "distributed digital manufacturing application" rather than just machines as capital equipment. The end goal is to reach a capability for maintaining digital inventory of high-end printed mechanical parts in digital form: print them as you need them, where you need them, only the quantity you need, in the best quality at competitive prices, with the highest yield and throughput possible for that point in time, specifically for high mix/low volume scenarios."

3D printed bone approved for patients from Europe

Surgeons in Europe now have access to MyBone, a patient specific 3D printed bone, to treat patients with severe facial deformations.

More from the News

This 3D printed bone is made of hydroxyapatite, a calcium phosphate which is the main mineral component of natural bone. MyBone is 3D printed with a porous structure by Cerhum, a medical device company in Liège, Belgium.

MyBone is authorised under the Medical Device Regulation 2017/745 (MDR), registered with the Belgium Competent Authority (FAMHP, registration number BE/CA01/1-72228) and ISO 13485 certified.

MyBone is made available to a first batch of maxillofacial and orthopaedic surgeons as a patient-specific implant. For example, two years ago, as part of a controlled release phase, a complex and challenging case was done in which a patient received such a 3D printed bone implant. The patient is doing well, and the implant looks exactly like natural bone on a recent CT scan.

Dr Christophe Ronsmans, head of department of plastic surgery, CHR Liege says: "Given the complexity of the defect, it would have been impossible to achieve such perfection from an aesthetic point of view and such a functional result with current methods."

Grégory Nolens, Cerhum founder and CSO said: "We are very proud to have successfully gathered vital clinical data and passed all the regulatory hurdles with a synthetic bone graft that is safe and effective. Our 3D printed bone implants offer a unique, patented porous structure that allows ingrowth of blood vessels. This process, called vascularisation is key to achieve successful bone ingrowth. As a result, MyBone has shown 7x faster bone ingrowth than currently available bone graft granules. Due to extremely positive feedback of maxillofacial surgeons so far, Cerhum is expanding its portfolio into the dental and oncological market."

ANCA and CSIRO developing novel 3D printing technology to manufacture cutting tools

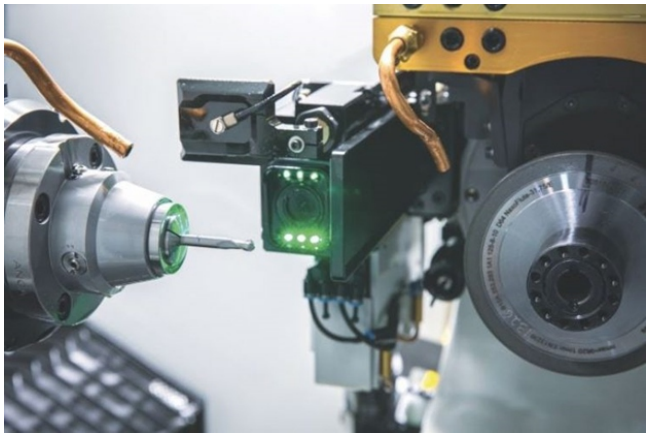


Image Supplied: www.imcrc.org

Australian industry will soon have access to an innovative cutting tool manufacturing platform, thanks to a research collaboration between leading tool manufacturer ANCA and Australia's national science agency CSIRO.

More from the News

The nine-month, $928,000 project, which is supported by the Innovative Manufacturing Cooperative Research Centre (IMCRC), is developing a new additive manufacturing (3D printing) process for tungsten-carbide tools.

The additive manufacturing technology will enable affordable, high-performance tools to be manufactured using one platform, replacing the current production process of mould pressing, sintering, brazing and grinding.

Now in the advanced phase, the research is focused on refining the additive manufacturing technology ahead of ANCA taking the hybrid manufacturing platform to market.

Dean McBain, Research & Technology Manager at ANCA, said the project had the potential to transform the way tungsten-carbide brazed insert tools were made in Australia and across the world.

"ANCA's collaboration with IMCRC and CSIRO has accelerated the development of an innovative additive manufacturing technology which we believe has the potential to disrupt the $2.2B global cutting tool market," he said.

"Successful completion of this project will allow ANCA to commercialise the new hybrid additive manufacturing machine platform, grow our workforce and revenue and fill a significant gap in the global tooling market."

Dr Kathie McGregor, Research Director for Advanced Materials and Processes at CSIRO, said the project would make metallic additive manufacturing technologies more accessible to Australian industry.

"In keeping with CSIRO's role of providing high-end research and development (R&D) support to the Australian industry using state-of-the-art equipment and world class know-how, we have collaborated with ANCA to further develop a unique technology," she said.
"We expect the outcomes may enable ANCA to diversify and grow its business and provide a boost to the local economy in terms of additional job opportunities and export income."

Dr Matthew Young, IMCRC's Manufacturing Innovation Manager, said IMCRC was pleased to be supporting ANCA's innovation, and in turn, contributing to the growth of Australia's advanced manufacturing ecosystem.

"As ANCA and CSIRO's R&D partnership demonstrates, additive manufacturing can generate significant benefits for Australian manufacturers, reducing costs and improving speed to market," he said.

"Once developed, this revolutionary technology can be applied to a range of cutting applications, creating significant global export opportunities and furthering ANCA's position as a market- leading manufacturer of cutting tools and equipment."

MacLean-Fogg Announces the Grand Opening of new Sterling Heights' Additive Manufacturing Operation

MacLean-Fogg Component Solutions of Mundelein, IL, announces the grand opening of the MacLean Additive facility in Sterling Heights, MI. This new facility will be focused on the production of 3D printed components and tooling, as well as the distribution of MacLean Additive's award winning "Formetrix L-40" steel powder for tooling applications.

More from the News

"With the addition last year of the Formetrix portfolio to our existing additive manufacturing activities, we quickly outgrew our initial MacLean Additive space in Macomb, MI. This facility gives us the room we need to develop our durable tooling product lines, support our ever-growing steel powder customer base, as well as continue our 3D printed production part activities," said Greg Rizzo, Vice President and General Manager for MacLean Additive.

A Grand Opening ceremony will take place at 2 p.m. on July 6, 2022 at the MacLean Additive facility located at 7689 19 Mile Rd. Sterling Heights, MI 48314. Credentialed media is welcome to attend, however no photographs will be allowed inside the building. Among local dignitaries and invited guests, the ribbon on the new facility will be cut by MacLean-Fogg President and CEO, Duncan MacLean. "Our Grand Opening guests will see that we have a lot of room to grow in this 35,000 square foot facility. We didn't choose this large a facility because it was the only one available, we choose this facility because we know we'll have the demand to fill it," stated MacLean.

"MacLean Fogg had a choice of where to locate this new additive manufacturing facility, and they chose Sterling Heights," said Sterling Heights Mayor Michael Taylor. "Their decision to locate in our community underscores the solid reputation we have for welcoming our business community and really engaging with them to ensure their success. The Sterling Innovation District is strategically located at the heart of customer demand and access to the specialized engineering and technician talent needed to fill that demand. That makes it a perfect fit for cutting-edge manufacturing facilities like MacLean Additive."

X-Bow Systems to Deliver World's First 3D Printed Rocket Factory In-A-Box to US Air Force

X-Bow Systems Inc. (X-Bow), a new non-traditional small business supplier of Solid Rocket Motors (SRMs) and defense technologies, announced today that its Pathfinder I, a mobile energetics factory demonstration unit (aka Rocket Factory In-A-Box) will be delivered this month to the US Air Force Research Laboratory (AFRL) in Edwards, California.

More from the News

Pathfinder I is part of X-Bow's groundbreaking, low-cost additive manufacturing approach to solid rocket motors, developed in conjunction with, and as part of, AFRL's Eternal Quiver Program.

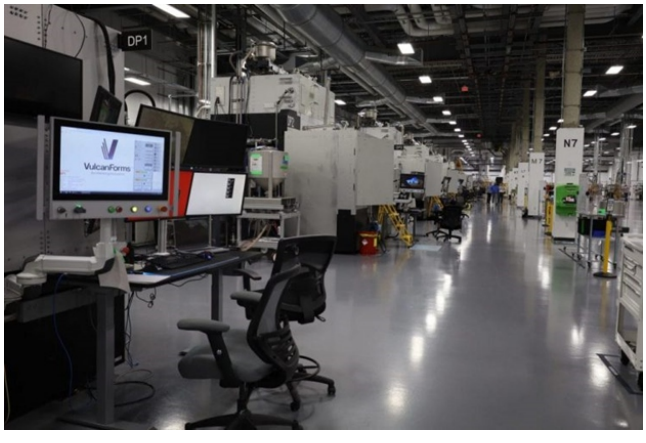
X-Bow's Rocket Factory In-a-Box (RFIB) Pathfinder I is an inert demonstration unit of a mobile, containerized Solid Rocket Motor (SRM) "factory" that combines innovative design, automation, and additive manufacturing techniques. Pathfinder I operates in a small footprint and greatly increases flexibility in the manufacturing and fielding of rockets to specific missions. The X-Bow approach removes many design constraints and delays that are inherent to the current methods of producing SRMs. X-Bow's design and modular manufacturing techniques, together with state-of-the-art automation and digital engineering, enable affordable rocket propulsion anytime, anywhere.

"Advanced propulsion technology, cutting-edge manufacturing, and our talented and dedicated team of engineers are critical to developing next-generation rocket solutions," said Jill Marsh, RFIB Program.

Manager at X-Bow System. "Over the next several years, X-Bow aims to work together with AFRL to identify projects and technologies to evolve the Pathfinder I capability for use in defense and other applications."

"I look forward to our continued collaboration with X-Bow Systems and witnessing their technology change and modernize how we manufacture solid rocket motors. We eagerly look forward to receiving the world's first Rocket Factory In-a-Box Pathfinder and evaluating the amazing potential this technology brings to our mission. The pace of the world's threats and evolution of capabilities means we cannot stand still. This demonstration unit will allow us to redefine what solid rocket motor production means in the 21st century," said Dr Shawn Phillips, Chief Rocket Propulsion Division of AFRL Rocket Lab, located at Edwards AFB, CA. "X-Bow is poised to deliver the world's first tactical mobile energetics factory demonstration unit. The significance of this technology and what it could do to enable tactical responsive space access, increase the solid rocket motor industrial base resiliency and production capacity, shorten the design and production timelines and radically lower the cost for hypersonics, tactical missiles, missile defense and other commercial applications is now a significant step closer with this AFRL backed endeavor," states X-Bow CEO Jason P. Hundley. "We look forward to demonstrating its capabilities and further collaboration with AFRL Edwards in radically pushing the paradigm of solid rocket motor design development forward."

VulcanForms raises $355 million to fund "breakthrough" 100kW laser 3D printing



VulcanForms' new manufacturing facility.
Photograph by way of VulcanForms.

Digital manufacturing agency and MIT-rollout VulcanForms has raised $355 million, taking its valuation to over $1 billion.

More from the News

The agency additionally unveiled its first two digital manufacturing amenities, considered one of which is powered by its fleet of proprietary 100kW class laser powder mattress fusion (LPBF) 3D printing programs, totaling two megawatts of laser capability.

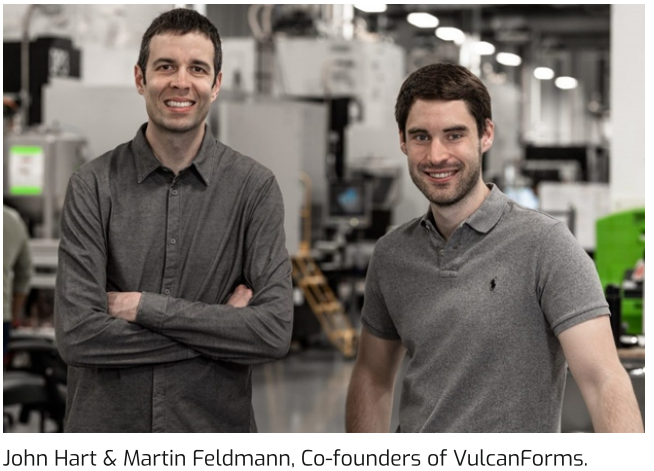
"By scaling superior digital manufacturing, we will create a brand new period of U innovation and financial progress," stated Martin Feldmann, VulcanForms Co-founder. "We've acknowledged a game-changing alternative when additive manufacturing know-how is scaled for industrial manufacturing and is seamlessly built-in with automated machining and robotics."

VulcanForms' laser 3D printing know-how

VulcanForms was based by Feldmann and Professor John Hart at MIT in 2013 with the purpose of enhancing the throughput and high quality of the LPBF additive manufacturing course of. After submitting its first patent utility two years later, the agency constructed its first system to validate its breakthrough industrial 3D printing know-how in 2017.

In 2019, the corporate's first manufacturing machine was developed, able to delivering as much as 100kW laser energy to the powder mattress, which is as much as 250 instances greater than that of different industrial programs in the marketplace. The corporate's proprietary simulation instruments, in-process sensing, and machine algorithms monitor the whole manufacturing course of with a purpose to maximize productiveness and guarantee constant high quality throughout every machine.

Over the previous few years, the corporate has grown to serve main corporations within the protection, aerospace, medical, and semiconductor industries with precision-engineered parts and assemblies. As an illustration, VulcanForms provides over a dozen US Division of Protection (DoD) packages, together with the F35 Joint Strike Fighter and Patriot Air Protection System, and has additionally created 1000's of parts for the semiconductor sector.



John Hart & Martin Feldmann, Co-founders of VulcanForms.

"VulcanForms has constructed the bodily infrastructure and digital workflows to ship this full-stack manufacturing resolution at unprecedented velocity, precision, high quality, and scale," stated Feldmann. "Our applied sciences mixed with our crew of engineering and operations leaders from Google, Normal Electrical, Pratt & Whitney, Precision Castparts, IPG Photonics, Faro Applied sciences, Schlumberger, Alcoa, Autodesk, amongst others allow our prospects to innovate, develop and ship sustainable impression quicker."

A $355 million rise in capital

VulcanForms secured its first bout of seed funding from Eclipse Ventures in 2017 and went on to efficiently full a Sequence A funding spherical in 2019 to ascertain its headquarters in Burlington, Massachusetts.

Now, the corporate has obtained one other substantial capital injection totaling $355 million, taking its valuation to over $1 billion. The funding spherical noticed participation from Eclipse Ventures, State Enterprise Companions, Fontinalis Companions, D1 Capital Companions, Normal Investments, Atlas Innovate, Boston Seed Capital, Business Ventures, and the Simkins Household.

The extra funding will help the corporate in offering new and present prospects with its built-in method to LPBF additive manufacturing in a bid to permit them to innovate quicker and at scale, with out making massive capital investments of their very own.

"VulcanForms brings forth steel additive manufacturing as a scalable industrial course of, and as a cornerstone of breakthrough digital manufacturing programs," stated Hart. "Built-in digital manufacturing amenities are essential infrastructure which is able to speed up home and international innovation and draw prime expertise to the manufacturing sector."

Alongside the brand new funding announcement, the corporate additionally revealed the completion of its

first two digital manufacturing amenities. VulcanOne, based mostly in Devens, Massachusetts, is kitted out with a fleet of the agency's 100kW LPBF 3D printing programs which in whole will ship greater than two megawatts of laser capability. In the meantime, its Newburyport facility, additionally in Massachusetts, will deal with automated precision machining and meeting operations.

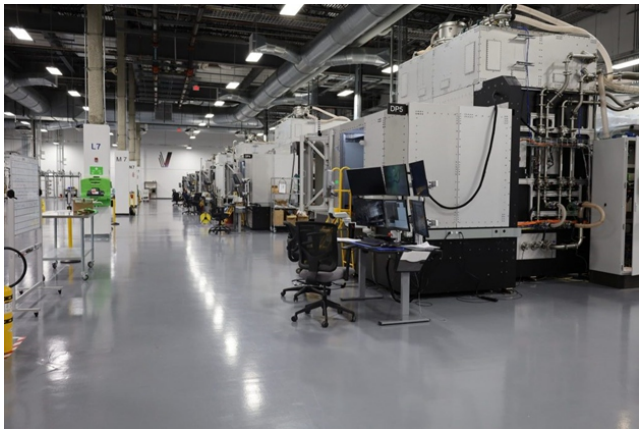
The 2 amenities can be linked by a digital thread to supply what VulcanForms says is a "groundbreaking" US-based digital manufacturing infrastructure to its prospects. Inside the VulcanOne facility, the shape's proprietary LPBF know-how can be mixed with a digital thread of superior simulation, in-process sensing, and machine studying algorithms designed to make sure the very best stage of high quality and precision.

The agency's fleet of 100kW LPBF programs represents a $100 million funding by the agency, with the brand new facility additionally creating greater than 100 new 3D printing-related jobs on-site. By its two amenities, VulcanForms is aiming seamlessly combine additive manufacturing at scale with its warmth remedy, precision machining, meeting, and inspection capabilities.

With its new end-to-end digital-first course of chain, the corporate will have the ability to ship engineered parts and assemblies tailor-made to every buyer's wants, whereas additionally undoing the hurt that a long time of offshoring have precipitated the US manufacturing sector when it comes to displacing essential manufacturing know-how and infrastructure to different nations, and leaving international provide chains fragile.

"There's a basic shift within the methods producers must adapt to international provide chain challenges and the growing calls for for product design flexibility," stated Greg Reichow, Accomplice at Eclipse Ventures and Director of VulcanForms. "VulcanForms' full-stack method to delivering an engineered resolution, combining superior additive and subtractive applied sciences merged by means of a digital thread will revitalize US manufacturing and {hardware} innovation.

"The Applied Sciences That Allow This Agile Workflow Will Dramatically Impression The Best Way Merchandise Are Imagined, Designed, Constructed, And Delivered For Many Years To Return."



VulcanForms' new facility homes a fleet of 100kW laser 3d printing programs. Picture by way of VulcanForms.

Bettering US manufacturing resilience

Whereas current international occasions just like the Covid-19 pandemic, the Suez Canal blockage, and the scarcity of semiconductor chips have all uncovered vital weaknesses in provide chains all through the world, they've been beneath appreciable pressure for many years.

Distributed manufacturing has change into more and more interesting to producers wishing to shore up the resiliency of their operations, and 3D printing is one know-how with the potential to supply corporations with higher provide chain flexibility.

Within the US specifically, America Makes has initiated the Superior Manufacturing Disaster Manufacturing Response (AMCPR) program to showcase the function 3D printing can play in bolstering provide chains past the pandemic, whereas the American Petroleum Institute (API) has added a brand new normal designed to assist strengthen the provision chain resiliency of the nation's oil and gasoline corporations.

Research and Development News

NIMS and Osaka University researchers succeeded in 3D printing nickel single crystals

NIMS and Osaka University Graduate School of Engineering have succeeded in fabricating a nickel single crystal with only a very few crystalline defects by irradiating nickel powder with a large-radius, flat-top laser beam (i.e., a laser beam whose intensity is uniform across a cross-section of the beam). This technique may be used to fabricate a wide variety of single-crystalline materials, including heat-resistant materials for jet engines and gas turbines.

More from the News

Widely-used technology may accelerate development of heat-resistant jet engine components

Previous studies have reported that single crystals can be fabricated using electron beam additive manufacturing. However, this technique requires expensive equipment and its operation is also costly due to the need to create a vacuum, limiting its widespread use. Although laser additive manufacturing can be performed using cheaper equipment, previous efforts to fabricate single crystals using this technique had failed. When a raw metal powder material is irradiated with a laser beam, it melts, forming a solid-liquid interface. It had been difficult to grow grains near the interface in the same direction and to prevent the formation of strain-inducing defects caused by their solidification. This problem was found to be attributed to the intensity profile of conventional Gaussian laser beams (i.e., laser beams with a bell-shaped intensity across a cross-section of the beam), which causes the formation of polycrystals composed of less oriented crystalline grains with many grain boundaries.

This NIMS-Osaka University Graduate School of Engineering research team succeeded in fabricating single crystals using a flat-top laser beam, forming a flat melt pool surface on the nickel powders. Individual crystalline grains grew in the same direction with fewer strain-inducing defects. Single crystals without grain boundaries, which are susceptible to cracking, are very strong at high temperatures. This new technique allows to minimize strain generation and cracking of crystals during their solidification. In addition, this technique does not require the use of seed crystals, simplifying additive manufacturing processes.

In addition to nickel, this laser additive manufacturing technique can be used to process other metals and alloys into single-crystalline objects. Jet engine and gas turbine components are becoming more complex in shape and lighter, and demand for additive manufacturing of these components using heat-resistant nickel-based superalloys is growing. Because single crystals are stronger than polycrystals at high temperatures, their practical use as heat-resistant materials is promising. Global R&D efforts to achieve this using cheaper and widely used laser additive manufacturing technology is expected to intensify rapidly.

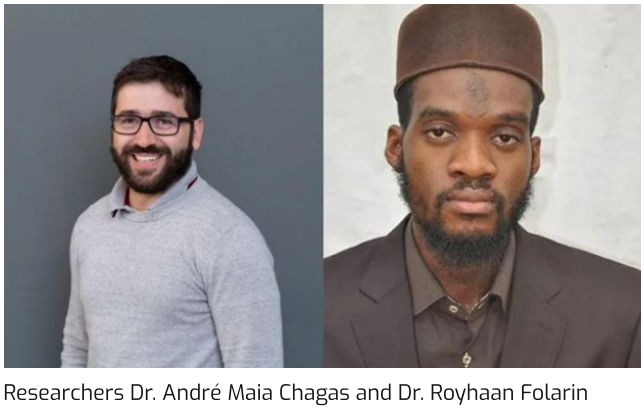
Researchers Used 3D Printing to Solve PPE Shortage in Nigeria

A recent academic paper has revealed that researchers from the University of Sussex and the Olabisis Onabanjo University in Nigeria turned to 3D printing and open-source designs to help deal with a shortage of personal protection equipment (PPE).

More from the News

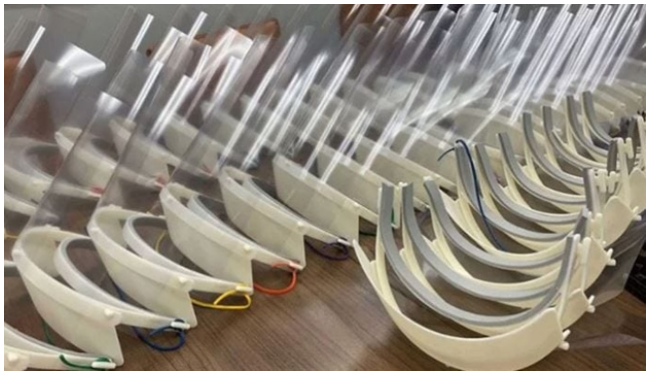
Like many countries, this shortage arose in Nigeria during the Covid-19 pandemic. Andre Maia Chagas from the University of Sussex, and Dr. Royhaan Folarin from the Olabisi Onabanjo University in Nigeria explained the project in an article that was published in the latest issue of the monthly scientific journal PLOS Biology.

The Covid-19 pandemic hit the entire world without a warning and caused damage that still affects our everyday lives. However in times like now, when the pandemic seems to be coming to a state where everyone can slowly start to recover and process all that has been turning our lives upside down, we start to learn how the challenging situation impacted other parts of the planet. When the coronavirus found its way to Africa, more precisely Nigeria, it didn't take long for the situation to turn problematic. The African country, given its population's poverty and its unstable economy, quickly ran short on personal protection equipment (PPE) for its medical staff, which, as you know, is very important when dealing with the contagious virus.



Researchers Dr. André Maia Chagas and Dr. Royhaan Folarin (photo credits: Ralf Rebmann / scicomnigeria)

In an effort to solve the problem as quickly as possible, Dr. Andre Maia Chagas and Dr. Royhaan Folarin together searched for a possible solution. The researchers turned to additive manufacturing, which presented a great opportunity to not only produce 400 pieces of urgently needed PPE on time but also enabled cheaper and more sustainable production. The team managed to obtain the approved PPE designs via open-source, and without hesitation, 3D printed equipment for the local community to use, which turned out to cost less than half of what the usual equipment would have cost.
Dr.Andre Maia Chagas, who works as a Research Bioengineer at the University of Sussex, commented on the project, noting, “Through knowledge sharing, collaboration and technology, we were able to help support a community through a global health crisis. I'm really proud of the tangible difference we made at a critical time for this community. As PPE was in such high demand and stocks were low, prices for surgical masks, respirators and surgical gowns hiked, with issues arising around exports and international distribution. We quickly realized that alternative means of producing and distributing PPE were required. Free and open-source hardware (FOSH) and 3D printing quickly became a viable option.”



An example of 3D printed PPE (photo credits: America Makes)

3D Printing Helped Charities to Provide PPE

The collaboration between the two researchers initially came together through a charity network called TReND in Africa. The initiative, brought to life by the University of Sussex, supports scientific capacity building in developing countries in Africa. The University's experts work together with local researchers or doctors and

share their knowledge in innovation, technology, and medicine.

"During the pandemic, we saw the successful printing and donation of PPE in the Czech Republic by Prusa Research and it became a goal for me to use the training I had received in previous TReND in Africa workshops to help impact my immediate community in Nigeria." – Dr. Royhaan Folarin, Neuroscientist and lecturer of anatomical sciences at Olabisi Onabanjo University

The project's success prompted other professionals to further test and optimize the process since the 3D printer the team used was not built for large-scale serial manufacturing. Ultimately, the process was further advanced for industrial production, and companies started to use 3D printing technologies to produce and ship PPE to places in need around the world.

ETH zurich's new 3D printing method creates functional and decorative 'HiRes concrete slab'

image © Andrei Jipa

A research team at ETH Zurich displays a decorative new ceiling called the HiRes Concrete Slab, which had been created with a new, energy-saving fabrication method. The prototype occupies ETH Zurich's NEST Research Building — a so-called living lab which had just been completed this past fall in Dübendorf, Switzerland.

More from the News

The work has been installed within the two-story 'HiLo unit,' an office space used by a robotics research group. and showcases the advantages of the technologies — such as 3D-printed formwork — which the team is currently exploring.

THE INNOVATIVE FABRICATION PROCESS OF THE HIRES CONCRETE SLAB

The development of the thin-shell HiRes Concrete Slab involved a collaboration between ETH Zurich's Digital Building Technologies (DBT) team, its Block Research Group (BRG), and Architecture and Buildings Systems (A/S). The work at once showcases the function and efficiency of the technology and the 'spectacular aesthetic of free form.'

To make the slab, concrete is poured into 43 thin 3D-printed molds which are held by a laser-cut timber waffle. 'The 3D-printed parts are only five centimeters in thickness to reduce material and production costs.' The process further allows for the integration building services including heating, cooling and ventilation during the construction process. Four custom ventilation ducts developed by the A/S team were 3D printed with polymer into the structure before the concrete was poured.

The team comments: 'This new approach can have a significant positive impact on the built environment: reducing embodied carbon and operational energy, increasing user comfort, and giving architects unprecedented design freedom.'

image © Andrei Jipa

THE PART-TO-WHOLE ASSEMBLAGE

The HiRes Concrete Slab at ETH Zuruch's NEST research building takes shape as a thin, doubly-curved shell based on the structural concept developed by BRG. The group elaborates: 'Vertical stiffeners transfer loads to the boundary supports through compression forces only. The forces are concentrated in the corners, where their horizontal thrust is distributed to post-tensioned ties.

'Thus, material is placed only where it is structurally needed, according to the flow of forces through the shell. This approach results in a 70% reduction of material compared to a standard reinforced concrete slab.'

The slab as a whole is assembled as a collection of parts which easily fit together. The seams between each part are read as the most prominent contours, suggesting the a continuous, uninterrupted surface.

HIGH-RESOLUTION CONCRETE

Along with its aesthetic qualities and ultra-efficient fabrication process, the highly-articulated soffits of the HiRes Concrete Slab enhance the acoustic qualities of the space. The team at ETH Zurich explains: 'the flowing contours reach their highest density in a central peak and fade out towards the perimeter.' This decorative pattern is informed strictly by its function, the constraints of the fabrication process, and efficient assemblage and demountability.

Montana State University researchers unveil 3D printing technology that could advance biofilm science

MSU microbiology doctoral student Kathryn Zimlich, left, and Isaak Thornton, doctorate student in

mechanical engineering, with a 3D printing device they have used to deposit microbes and create biofilms. MSU Photo by Adrian Sanchez-Gonzalez

Combatting life-threatening bacterial infections, reducing slime that clogs pipes, preventing plaque buildup on teeth — all could one day benefit from a new technology being developed by Montana State University researchers using 3D printed biofilm.

More from the News

When bacteria and other microbes stick to surfaces and create slimy mats — called biofilm — they form complex communities that are often resistant to traditional disinfectants. Now, scientists in MSU's Center for Biofilm Engineering are developing a tool for replicating the microbial mosaics so that innovative treatments can be studied.

"We're excited to share the first glimpses of this technology," said Isaak Thornton, who is earning his doctorate in mechanical engineering. Thornton, along with microbiology doctoral student Kathryn Zimlich, will present their work during the annual Montana Biofilm Meeting in Bozeman on July 12-14, which convenes researchers and industry partners from around the world to discuss the latest biofilm science.

For the past two years, Zimlich and Thornton have designed and tested a 3D printing device that can precisely lay out a grid of individual bacteria in hydrogel — a clear, Jell-O-like substance. Tapping into advances in 3D printing, the researchers can map out the microbes within drops of liquid hydrogel resin and then use laser light to solidify the material, constructing a rudimentary biofilm.

"We can spatially arrange and encapsulate cells exactly where we want them," said Thornton, who is conducting the research in the lab of Jim Wilking, associate professor in the Department of Chemical and Biological Engineering in MSU's Norm Asbjornson College of Engineering.

So far Zimlich and Thornton have only used a single species of bacteria, but by using the 3D printer to do multiple passes, each with a different species or strain of bacteria, they could start to create the more complex and layered biofilms found in nature. By adding fluorescent dye to the bacteria, the researchers can easily see the microbes using specialized microscopes, allowing them to study the interactions that happen among the cells.

"Even the simplest biofilm systems are complicated," Zimlich said. "It's like a forest where there's a lot of diversity. We've needed new tools to see how that diversity develops and is maintained."

It's known that the dynamic environment within a biofilm can contribute to making microbes resistant to traditional treatments. MSU Regents Professor and longtime biofilm researcher Phil Stewart has shown that a bacteria that commonly causes dangerous wound infections resists antibiotics because the cells in the lower level of the biofilm are cut off from oxygen and other compounds, causing them to go dormant and thereby changing their biology enough that the drug is rendered ineffective.

"One thing that's becoming clearer is that there's potential to treat these pathogenic bacteria by altering the interactive biofilm environment instead of trying to use harsh chemical products," said Zimlich, whose research adviser is Matthew Fields, director of the Center for Biofilm Engineering. For example, treatments could involve introducing harmless bacteria that compete with the harmful microbes and disrupt the protective biofilm.

Developing those treatments will require lots of testing in a controlled lab environment, which is where the new 3D printing tool comes in.

"We think it's possible to construct analogs of how these pathogenic biofilms form naturally," Zimlich said. That's potentially of great interest to the attendees of the biofilm meeting. Companies like Proctor and Gamble, 3M and Ecolab, as well as NASA, are eager to

develop new ways of effectively controlling problem biofilms, according to Paul Sturman, who coordinates the center's work with its roughly 30 industrial partners.

"It's really all about helping them develop products that are useful," Sturman said. "The meeting is a great way for our members to keep apprised of the latest biofilm research. And we get to showcase the work we're doing and are capable of doing."

Since it was founded more than 30 years ago, the Center for Biofilm Engineering has been a world leader in the study of biofilms, pioneering an interdisciplinary approach that combines multiple areas of engineering, microbiology and other fields to solve real-world problems. That's what attracted Thornton to the project, he said.

"It's rewarding to have this opportunity to bring my skills in mechanical engineering to help microbiologists answer a new generation of questions," Thornton said.

Zimlich agrees. "We have to work together," she said. "I think this is one of the best places in the world to be exploring these questions."

Researchers at University of Sydney Developed Surgical Planning Tools Using 3D Printing and Digital Technology

Professor Qing Li and Ben Ferguson.
Image: University of Sydney

Surgical planning tool designed by Engineering PhD student advances the efficacy of next generation 3D-printed bone implants.

More form the News

Jawbone reconstruction – or orthognathic surgery – is a complicated medical procedure whereby a person's jaw is treated for significant trauma, such as from a car crash or gunshot wound, or diseases like oral cancer.

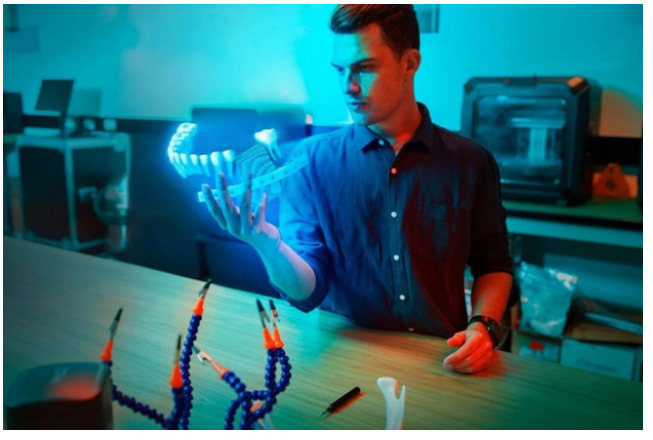
Jaw reconstruction surgery involves replacing damaged or diseased bone tissue with an implant, typically a titanium plate or prosthesis, with patient recovery taking as long as twelve weeks. Complications like implant failure and infections are common, potentially requiring repeat surgery which can place significant burden on a patient.

In recent years, biomedical engineers have developed a new generation of medical implants designed to not only substitute bone, but to help regenerate tissue back to its original state using 3D-printed tissue scaffold-fixation systems. These devices enhance the innate healing potential of human tissue, using a scaffold as a temporary support structure for the surrounding cells to attach to and grow. Eventually, the scaffold is expected to dissolve into the blood stream, leaving new tissue in its place.

Ben Ferguson, a PhD student in the University of Sydney's School of Aerospace, Mechanical and Mechatronic Engineering, is developing a surgical planning tool to assist surgeons in planning complex jawbone reconstruction procedures using these new generation devices.

Using advanced computational technology and decision-making algorithms, the tool works by generating a 'digital twin' of the patient using CT scan data. It then rapidly simulates different designs of the implant before 3-D printing the final, optimal design, allowing surgeons to perform a digital 'rehearsal' prior to theatre.

"Nowadays, it would be unthinkable to construct a building without running an engineering simulation on it beforehand. This is the industry standard in civil engineering – the same expectation should be applied to surgery on a human being," said Mr Ferguson, who is due to submit his PhD in September.



Ben Ferguson. Image: University of Sydney

"The jaw is a complex area – required to talk, eat, chew and perform tasks that require both finesse and strength. Because of its complexity, we want to give orthognathic surgeons the best tools so they are set up for success – hopefully reducing repeat surgeries and improving patient outcomes," he said.

"A bone implant design may work in one patient, but it may fail in another. If it was you – you would probably want a team of surgeons and biomedical engineers to run a simulation and assessment of the medical device in your body before it is actually implanted."

The surgical planning tool combines computer-aided design (CAD) tools with high-fidelity computer-aided engineering models and optimisation algorithms that can accurately simulate the medical device while under physiological load.

Mr Ferguson's supervisor, Professor Qing Li, said: "In addition to pre-surgical planning, this simulation data can also assist the surgeon in optimising the medical device's design, helping them resolve issues that inevitably arise when designing a device that must meet multiple design and medical objectives," said Mr Ferguson.

"It is a careful balancing act. For example, an implant may need to mechanically stimulate the surrounding tissue to enhance healing, but mechanical stimulation may then increase the risk of implant failure. Our algorithms and data-driven approach help surgeons develop an optimal design without having to rely solely on intuition."

The researchers have recently partnered with Professor Jonathan Clark AM, Chair of Head and Neck Cancer Reconstructive Surgery at Chris O'Brien Lifehouse to help translate the new technology into a clinical reality. Professor Clark said: "Australia has been a leader in jaw reconstruction since Dr Ian Taylor's 1974 breakthrough mandibular reconstruction. Since then, jaw reconstruction has evolved substantially: digital tools have been incorporated into pre-surgery planning, allowing surgeons to create more precise devices, with better aesthetic and functional outcomes for patients."

"What's really exciting about this tool and data is that they provide the opportunity to evolve the technology beyond form, to also include biomechanical modeling, which can help predict the bone tissue's response to physiological loads. This kind of analysis – termed CT-based finite element modelling – will be of great importance as we move away from using patient's own bonefor reconstruction and start to incorporate customised scaffolds in the future."

Texas A&M receives $3.74M for green, 3D-printed hempcrete buildings research

A plan from Texas A&M University researchers to 3D print new resilient buildings using hempcrete has the potential to lower the environmental impact of traditional construction methods and make housing more affordable and available.
More form the News
The project will be funded by a $3.74 million grant from

"No officer, those are my building materials."
(Image credit: Texas A&M University)

the U.S. Department of Energy Advanced Research Projects Agency-Energy (ARPA-E) Harnessing Emissions into Structures Taking Inputs from the Atmosphere (HESTIA) program.

Dr. Petros Sideris, assistant professor in the Zachry Department of Civil and Environmental Engineering, will lead the project as principal investigator to develop residential and potential commercial construction designs. His team consists of assistant professor Dr. Maria Koliou, department head and professor Dr. Zachary Grasley, and professor Dr. Anand Puppala from the department, and associate professor Dr. Manish Dixit and professor Dr. Wei Yan from the Texas A&M College of Architecture.

Hempcrete is made by mixing hemp powder, fibers or shives with lime and water, creating a lightweight, green building material.

The raw hemp hurds are one component of hempcrete, which is also made of lime, water, hemp powder and fibers. | Image: Getty Images

"While production of conventional construction materials such as concrete requires large amounts of energy and releases large amounts of CO2 (carbon dioxide), hempcrete is a net carbon-negative material, which can provide major environmental benefits," Sideris said.

Sustainability will be further promoted by designing hempcrete structures more resilient to natural hazards than commonly used lightweight wood frame construction.

"Resilience to natural hazards is intertwined with environmental sustainability because building damage and subsequent repairs due to extreme events such as hurricanes result in major environmental impacts," Sideris said.

Image: Courtesy of Petros Sideris

Researchers will use 3D printing in this project to create building designs that achieve structural and energy performance to comply with modern design codes. |

Hempcrete has already been used globally in residential construction and prefabricated modular construction.

"Hempcrete has excellent fire resistance and thermal insulating properties that can reduce heating and cooling energy demands," he said. "It is water-resistant and offers good acoustic properties."

As part of the project, building designs will be printable and created to achieve structural and energy performance that will comply with modern design codes. Sideris said digital designs of printable hempcrete buildings will facilitate adoption by the construction industry.

"The advancements of this project will contribute to the U.S. maintaining its worldwide leadership in advanced construction methods and infrastructure sustainability and resilient technologies," he said.

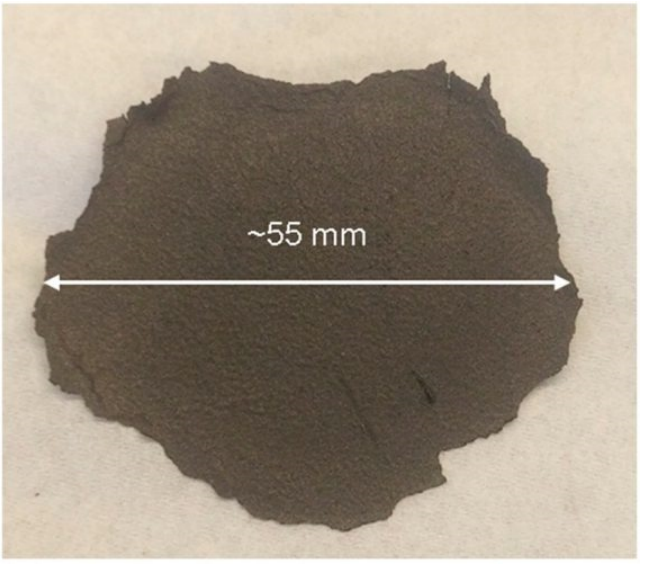
The funding is part of HESTIA, which prioritizes overcoming barriers associated with carbon-storing buildings, including scarce, expensive and geographically limited building materials. The HESTIA program aims to increase the total amount of carbon stored in buildings to create carbon sinks, which absorb more carbon from the atmosphere than released during construction.

Concordia University Researchers are Developing Photocuring Technology To 3d Print Graphene Oxide

Researchers from Concordia University, Montreal, are exploring the 3D printing of graphene oxide liquid crystals to enable materials with previously-unseen levels of strength.

More from the News

Having made headlines for over a decade, graphene is one of those wonder materials that promised to solve a number of our engineering challenges. The sheet-form



A large graphene oxide sheet produced via photocuring, the process behind resin 3D printing.
Photo via Concordia University.

carbon allotrope comprises a single layer of atoms arranged in a 2D nanostructure resembling a honeycomb lattice. The material is known for its high strength-to-weight ratio, excellent thermal and electrical conductivity, corrosion resistance, and scratch-resistant qualities.

Unfortunately, we haven't yet been able to translate graphene's strength from the microscale to real-world applications in the macroscale.

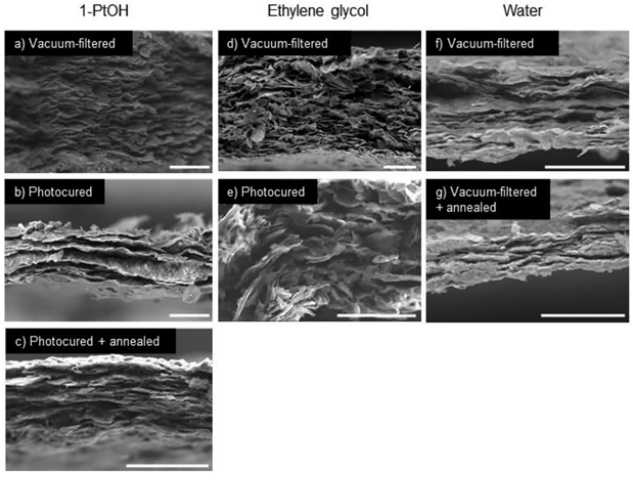
The Concordia team is now using photocuring, the technology behind stereolithography 3D printing, to produce self-assembled graphene oxide structures that are both larger and more complex than today's possibilities.

Graphene – the strongest known material

Andre Geim and Konstantin Novoselov discovered graphene in 2004, winning the Nobel Prize in Physics for their work shortly after in 2010. At just an atom thick, graphene is around a million times thinner than a human hair but offers a Young's modulus of 1TPa and a tensile strength of 130GPa. This makes it the strongest known material so far.

Although scaling graphene up is still a huge challenge, the self-assembly of graphene oxide sheets into liquid crystals is a promising approach to jumping the hurdle, as these liquid crystals could potentially be transformed into solid macroscopic structures.

Thus far, the self-assembly process has led to a whole host of macroscopic (albeit thin) structures such as paper, fibers, and aerogels. There are a number of methods for producing these structures, including wet-spinning, freeze-drying, and vacuum filtration. While these approaches do work to preserve the ordered structure in the liquid crystal phase, they're limited in the thickness and complexity of the structures produced.



SEM imaging of various graphene oxide sheets. Image via Concordia University.

The photocuring approach

The Concordia team turned to photocuring as an alternative. To prepare graphene oxide sheets, they first dispersed graphene in alcohol and mixed in a commercially-available photoinitiator called bis(4-methylphenyl) iodonium hexafluorophosphate. This is the same photoinitiator used in many of today's 3D printing resins.

The researchers found that they could successfully cure the resulting mixture into thin sheets of graphene oxide, turning it from a liquid state to a solid state using UV light. As such, the method is now thought to be compatible with 3D printing technology.

The novel photocured graphene oxide paper also impressed in a series of tensile tests, exhibiting mechanical properties comparable to those of a benchmark graphene oxide paper, which was prepared via conventional vacuum filtering.

The study writes, "We demonstrate that it is possible to photocure graphene oxide liquid crystals. Photocuring graphene oxide liquid crystals allows for thicker and perhaps more complicated structures than what is possible with current methods such as vacuum filtering or wet spinning."

Moving forward, the Concordia team would like to adapt the approach to full-scale stereolithography 3D printing in the hopes of fabricating large 3D structures made of graphene.

Further details of the study can be found in the paper titled 'Photocuring Graphene Oxide Liquid Crystals for High-Strength Structural Materials'.

The additive manufacturing of graphene-based materials has certainly been explored before. Researchers from China's Harbin Institute of Technology recently 3D printed a soft graphene oxide robot capable of moving backward and forwards when exposed to moisture. The project involved using Direct Ink Writing (DIW) 3D printing and constrained drying techniques, which addressed manufacturing challenges related to porosity, shrinkage, and structure uniformity.

Elsewhere, researchers from Carnegie Mellon University (CMU) and the University of Connecticut (UConn) 3D printed novel calcium phosphate graphene (CaPG) scaffolds that could one day be used for bone regeneration applications. The bioprinted structures offer several desirable properties such as osteoinductivity, biological safety, a long shelf-life, and reasonable production costs.

The 4D-Printed Beetle That Changes Color developed by researchers at Eindhoven University Of Technology

In an recent study PhD student Jeroen Sol from Eindhoven University Of Technology developed a 4D-printed beetle that changes color when exposed to water.

3D printing has become mainstream. For a few hundred euros you can buy a 3D printer online. But what about 4D printing? How do you print an object that can change over time, for example by reacting to touch, light or moisture? It turns out that this is not as easy as you might think. PhD student Jeroen Sol took up the challenge. He found inspiration in the world of the longhorn beetle and other animals that use iridescence and other forms of color change.

Sol's research group, led by professor Albert Schenning, has extensive experience with smart materials that respond to external stimuli, such as light, temperature or humidity. The materials use liquid crystal technology, similar to the techniques used in LCD screens, but applied in plastics. These crystals acquire different properties depending on the direction in which they are aligned (they become anisotropic). This can be either mechanical, in which case they become stronger in one direction than in the other, or optical, in which case they have a different color depending on the angle of incidence of the light.

An iridescendent beetle

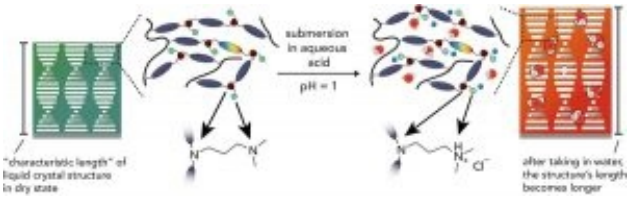
The latter is exactly what Sol has been working on for the past four years. Is it possible to print an object that changes color under the influence of humidity? "I found the inspiration for this in nature, and in particular in the Tmesisternus isabellae, a species of longhorn beetle whose elytra changes color in response to humidity."

That Sol chose moisture as a stimulus, rather than light (as PhD student Marina Pilz da Cunha from the same research group did earlier for her walking mini-robot), is not an accident. "Humans are largely composed of water, and a sensor that can easily and cheaply be printed using a 3D printer, and that responds to moisture, could have all kinds of applications in healthcare. Think of a ring that measures perspiration, or in the future maybe your blood sugar."

But Sol went a step further. He actually printed a beetle. "In the world of materials science it is very important that you make a demonstrator that proves that your invention actually works. And the choice of an animal is obvious, because there are numerous animals that make use of iridescence and other forms of color change, for example for camouflage."

A bath of acid

But how does this beetle work? Sol explains. "First I printed a beetle from hard plastic, and applied elytra to it with photonic ink. This was also done with a printer. I then treated this layer with an acid. This causes the crystals in the ink to react to moisture. With more



moisture, the material swells, so to speak, stretching the spiral structure of the crystals. This then changes the color."

The beauty is that you can manipulate sensitivity to moisture, by making the molecules less or more charged. "That opens up all kinds of possibilities for future applications."

Next, the researcher placed the beetle in an enclosed space where he could control the humidity. With more moisture, the green beetle slowly became redder and redder. If he brought the moisture level back down, the beetle turned green again.

"The latter is crucial," says Sol. "That means the effect is reversible. Without the user having to reset it, it can be used again as a sensor or actuator."

Future

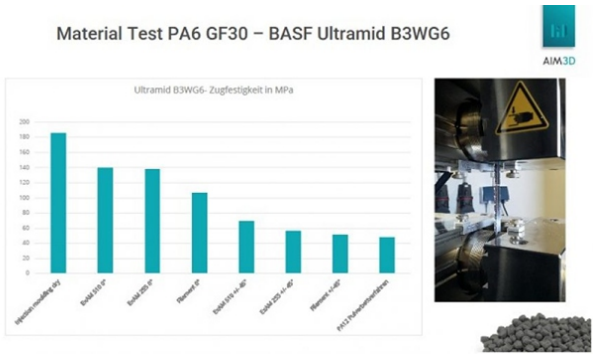
The young researcher talks about his research with infectious enthusiasm. "I think it's very important that we make it clear to the outside world what scientists are doing. People really don't need to understand every detail, but they do need to know what we are up to. That's why I like teaching so much. Transferring knowledge to other people."

The researcher has since found a new job at a spin-off of his research group, Lusoco. The company is working on the development of fluorescent inks for lighting, power generation and buildings, for example.

"I'm really looking forward to that. Moreover, the company is located on campus, so for now I won't be leaving here!"

AIM3D and University of Rostock conducted research on Composite Extrusion Modelling (CEM) process

The composite extrusion modelling 3D process shows great potential in terms of cost-effectiveness



compared to alternative 3D printing processes. In cooperation with the University of Rostock, the start-up company AIM3D has conducted a series of tests with PA6GF30 (BASF Ultramid B3WG6) material.

Test specimens were printed on the AIM3D ExAM 255 and ExAM 510 machines and the tensile strength of the specimens was compared with alternative processes such as injection moulding and conventional 3D printing. Evaluations of the material tests were surprising: printed PA6GF30 is clearly superior to other 3D printing processes and almost achieves the tensile strength of classic injection molding.

Highlights

- Tests series at the University of Rostock: 3D printing with PA6GF30 taps into high tensile strengths
- PA6GF30 in 3D printing as a substitute for aluminium (Al)
- 3D printed glass-fibre reinforced polyamide exhibits high tensile strength

Today, PA6GF30 is an indispensable material in industrial series production applications, almost ideally combining high mechanical properties with temperature and media resistance. PA6GF30 is thus a fully established material for applications in automotive, special-purpose machine construction or in equipment technology. PA6GF30 components are highly suitable for replacement applications for metal or aluminium parts wherever operating temperatures allow (PA6GF30: 130°C in continuous use, 150°C for

short periods). With regard to mechanical properties, such as tensile strength, very high values were obtained by 3D printing on the AIM3D ExAM 255 and ExAM 510 systems (see Graph 1). Compared to powder bed processes or 3D printing processes that use filament materials, the CEM process systems achieve tensile strengths that come close to classic thermoplastic injection moulded processes.

Material tests and analyses in detail

First, tensile bars were printed on an ExAM 255 machine with PA6GF30 and on the larger ExAM 510 (which will be launched at Formnext 2022) (see Graph 1). The orientation of the 3D printed webs was also varied. 0° for a lay-up in line with the tensile direction (the orientation of the fibres was also in the tensile direction) and +/- 45° for a pattern with an alternating direction of +/- 45° to the tensile direction. On the one hand, the Rostock-based company compared this with data sheet values for injection moulding with the original material and on the other hand with filament use for comparable PA6GF30 filaments. In addition, a comparison was made with a PA12 material used for 3D powder bed printing,as this material is often used as a reference in 3D printing. Graph 1 shows that CEM technology is very close to injection moulding but has a significant advantage over filaments. This phenomenon is due, among other things, to the fact that the original granules used from BASF's injection moulding technology actually contain up to 3 mm long glass fibres which can withstand the tensile forces for a longer period. In comparison, the fibre length in the filaments is significantly shorter for technological reasons. Generally, a distinction is made between fibre-reinforced (GF) and fibre-filled (if only short fibres are used). If other characteristics from the data sheet of BASF's Ultramid B3WG6 material used in the testarealso considered, it is clear that the combination of high strength when 3D printing and the high continuous operating temperature of 130°C to 150°C means that this is a universally applicable material. Paired with excellent printability on the CEM systems, versatile applications such as grippers or handling tools can be printed in the future. Today, these components are usually milled from aluminium, which is material-intensive. In contrast to this, 3D printing shows great potential in terms of material costs, conserving resources, component weight, speedy component production and ultimately greater energy efficiency. A general approach when printing these components should not be forgotten: the application of bionic design approaches can increase performance of 3D printed components with regard to their mechanical properties. In summary, there are numerous positive aspects in terms of costs (unit costs) as well as the enhanced performance parameters of a 3D printed component. The results of the investigations at the University of Rostock will be part of a scientific publication.

Cost advantages gained through functional integration in 3D printing

Compared to conventionally manufactured components, the particular appeal of 3D printing lies in the so-called functional integration through 3D printing-compatible design approaches. Functional integration means that assemblies can be manufactured in one printing process, just one of the strategic advantages of 3D printing. AIM3D produced a motor mount-equipped extruder housing made of PA6GF30 as a demonstration of the process. The motor mount, two air ducts routed in the walls, a ventilation outlet and a mounting for sensors were all integrated into the housing as a single component. In the case of a conventional production strategy with milled aluminium parts, 3 to 4 parts would have had to be milled from one block, resulting in awaste of raw materials. In addition, time would be required during the design phase to devise a workaround to avoid the use of special tools such as slot drills etc. and to implement a suitable form-fitting connection of the components. The time spent writing CAM milling programs is also eliminated, especially for small batch production. Manual assembly work is significantly reduced, which also has a positive effect on the cost calculation of the parts.

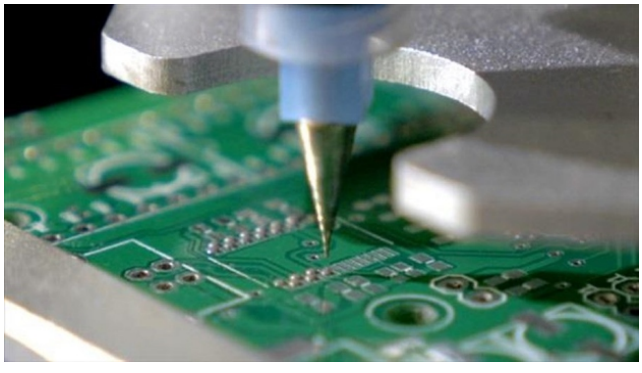
The CEM process: Convincing cost efficiencies

PA6GF30 is usually difficult to use for 3D printing. It is rather difficult to obtain and, where it is available, at 20 to 30 times the price of other materials(reference: 500 g of Owens Corning XSTRAND PA6GF30 | 3dmensionals filament costs approx. EUR 86). When processing with filaments, additives must also be used, which can have an unfavourable influence on both price and certification. Original granulates, as used in classic injection moulding applications, form the reference for costs at around EUR 5 – 6/kg. The CEM process is unique in enabling the use of commercially available granules without filaments where the material procurement costs are the same as for injection moulding yet without the tooling costs. However, as a 3D printing process, it is more likely to be found in the small and medium-sized series production segment. In addition, there are the freedoms of 3D printing in terms of geometric freedom (such as undercuts), bionic designs or selective densities (different strengths, material savings, selective elasticity, etc.). Dr.Vincent Morrison, CEO of AIM3D: "Pricing that is comparable to injection moulding for raw materials which do not contain filaments is a tremendous advantage for our CEM 3D printing systems technology. Using PA6GF30, our ExAM 255 machine is able to produce both complex, delicate parts with fine print resolution, as well as large structural components with greater layer thicknesses, resulting in maximum cost-effectiveness with state-of-the-art 3D printing."

PA6GF30 as a substitution for aluminium (Al) in 3D printing

Of course, a state-of-the-art 3D printing process cannot match the cost-savings of injection moulding for medium-sized or large series production runs. Its advantages lie more in the production of smaller batches and bionic design approaches. However, 3D printing has the upper hand in the case of small to medium-sized production runs and rapid prototyping, sincehere tooling costs form a disproportionate part of price calculations. Above all, CEM process substitution formilled aluminium production solutionshas high potential, as Dr. Vincent Morrison explains: "Aluminium as a material is comparatively expensive because of itsenergy-intensive production."Aluminium parts are often milled from a solid block. This puts great pressure on pricing. Added to this are the current shortages of raw materials. PA6GF30 material printed with our CEM technology as an alternative production solutioncreates completely new dimensions in terms of cost efficiencies. This applies all the more when bionic design approaches come into play to increase component performance."

Study on 3D printing of 'organic electronics' published by researchers at University of Houston Cullen



When looking at the future of production of micro-scale organic electronics, Mohammad Reza Abidian — associate professor of Biomedical Engineering at the University of Houston Cullen College of Engineering — sees their potential for use in flexible electronics, bioelectronics and organic electronics via multiphoton 3-D printers.

The newest paper from his research group examines the possibility of that technology. "Multiphoton Lithography of Organic Semiconductor Devices for 3D Printing of Flexible Electronic Circuits, Biosensors, and Bioelectronics" was published online in Advanced Materials.

Over the past few years, 3D printing of electronics have become a promising technology due to their potential applications in emerging fields such as nanoelectronics

and nanophotonics. Among 3D microfabrication technologies, multiphoton lithography (MPL) is considered the state-of-the-art amongst the microfabrication methods with true 3D fabrication capability, excellent level of spatial and temporal control, and the versatility of photosensitive materials mostly composed of acrylate-based polymers/monomers or epoxy-based photoresists.

"In this paper we introduced a new photosensitive resin doped with an organic semiconductor material (OS) to fabricate highly conductive 3D microstructures with high-quality structural features via MPL process," Abidian said.

They showed that the fabrication process could be performed on glass and flexible substrate poly(dimethylsilosane). They demonstrated that loading as low as 0.5 wt% OS into the resin remarkably increased electrical conductivity of printed organic semiconductor composite polymer over 10 orders of magnitude.

"The excellent electrical conductivity can be attributed to presence of OS in the cross-linked polymer chains, providing both ionic and electronic conduction pathways along the polymer chains," Abidian said.

To demonstrate the potential electronic applications based on the OS composite resin, his team fabricated various microelectronic devices, including micro-printed circuit board, which comprises various electrical elements, and an array of microcapacitors.

Three dimensional bioprinting of organic semiconductor microdevices based on MPL has potential in biomedical applications including tissue engineering, bioelectronics and biosensors. Abidian's team successfully incorporated bioactive molecules such as laminin and glucose oxidase into the OS composite microstructures (OSCMs). To confirm that the bioactivity of laminin was retained throughout the entire MPL process, primary mouse endothelial cells were cultured on OS composite microstructures. Cells seeded on laminin incorporated OSCMs displayed evidence of adherence to substrate, proliferation, and enhanced survival.

"We also assessed the biocompatibility of the OS composite structures by culturing lymphocytes, namely splenic T-cells and B-cells, on the fabricated surfaces and compared them with control surfaces. After seven days of culture, OS composite polymers did not induce cell mortality with approximately 94 percent cell viability compared to the control surfaces," Abidian said. "In addition, the potential effect of OS composite polymers on cell activation was also studied. After seven days of culture, there was no significant difference in the expression of activation markers on the lymphocytes between OS composite structures and control surfaces."

Finally, Abidian proposed a maskless method based on MPL for fabrication of bioelectronics and biosensors. They fabricated a glucose biosensor similar to Michigan style neural electrodes. Glucose oxidase, an enzyme for the specific recognition of glucose, was encapsulated within the solidified OS composite microelectrodes via the MPL process. The biosensor offered a highly sensitive glucose sensing platform with nearly 10-fold higher sensitivity compared to previous glucose biosensors. In addition, this biosensor exhibited excellent specificity and high reproducibility.

"We anticipate that the presented MPL-compatible OS composite resins will pave the path towards production of soft, bioactive, and conductive microstructures for various applications in the emerging fields of flexible bioelectronics, biosensors, nanoelectronics, organ-on-chips, and immune cell therapies." Abidian said

Co-authors on the paper include former graduate students Omid Dadras-Toussi and Milad Khorrami; and postdoctoral researcher Anto Sam Crosslee Louis Sam Titus. Abidian praised the work of his students on this research and noted that Dadras-Toussi would be starting a new job with Medtronic, an S&P 100 company with $30 billion in yearly revenue, this month.

Sheereen Majd, associate professor of Biomedical

Engineering, and Chandra Mohan, Hugh Roy and Lillie Cranz Cullen Endowed Professor of Biomedical Engineering at UH Cullen College of Engineering are also co-authors. Abidian said his colleagues were significant collaborators for the research.

Journal Reference:

1. Omid Dadras-Toussi, Milad Khorrami, Anto Sam Crosslee Louis Sam Titus, Sheereen Majd, Chandra Mohan, Mohammad Reza Abidian. Multiphoton Lithography of Organic Semiconductor Devices for 3D Printing of Flexible Electronic Circuits, Biosensors, and Bioelectronics. Advanced Materials, 2022; 2200512 DOI: 10.1002/adma.202200512

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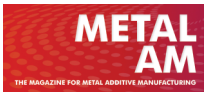

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