Benesch

3D Printing Report | Q1–Q2 2023

3D PRINTING—A FAST-MOVING MARKET

Developments in 3D Printing

A Sector by Sector Overview

This report explores developments in 3D printing across several sectors and categories for the half-year period of January 1, 2023–June 15, 2023.

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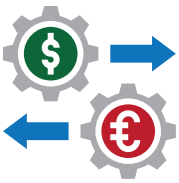


Transactions

Stratasys to Acquire Desktop Metal for $1.8B

Stratasys agreed to acquire Desktop Metal in an all-share deal valued at $1.8 billion. The deal brings together the polymer-based 3D printing expertise of Stratasys with the industrial mass production leadership of Desktop Metal's brands. Stratasys and Desktop Metal are expected to generate $1.1 billion in 2025 revenue, with significant upside potential in a total addressable market of more than $100 billion by 2032, said the companies. The deal is expected to close in Q4 2023.

3D Systems Buys Wematter to Grow SLS Portfolio

3D Systems acquired Wematter, a Swedish Selective Laser Sintering (SLS) 3D printer manufacturer. Launched in 2019, the Wematter Gravity SLS 3D printer can be bought for $60,000. This deal is anticipated to close in July 2023.

Nexa3D Acquires XYZ Printing Tech, Adding New SLS Technology to Portfolio

Nexa3D has completed the acquisition of Taiwanese 3D printer manufacturer XYZ Printing's SLS business for an undisclosed fee. As part of the deal, Nexa3D will obtain all XYZ technology, distribution, and service offerings, incorporating XYZ's popular MfgPro230 xS and MfgPro236 xS printers into their growing powder bed product portfolio.

3D Printed Rocket Firm Launcher Acquired by Vast

Vast has completed the acquisition of Launcher for an undisclosed fee. Through this deal, Vast hopes to accelerate its mission of developing artificial gravity space stations. With the acquisition, Vast will get a team of experts that will help speed up its manufacturing and development. The team is set to occupy the 115,000 square-foot Vast headquarters building, in Long Beach, CA. Vast also gains access to established spacecraft technologies. The company plans to use Launcher's Orbiter space tug and hosted payload platform to achieve orbit this year and test its on-orbit space station components and subsystems. Launcher has a history of space rocket engine production, having completed successful testing on its E-2 liquid rocket engine, achieving nominal thrust, pressure, and oxidizer/fuel mixture ratio for the first time in 2022.

Facebook Owner Meta Ramps Up AR Technology R&D Efforts with Acquisition of 3D Printing Firm Luxexcel

Meta has acquired prescription lens 3D printing specialist Luxexcel. Using its proprietary technology, Luxexcel is able to embed smart devices like waveguides, holographic films, and LCD screens directly into the lenses of glasses. With the purchase, Meta will likely deploy 3D printing in the development of further (AR) glasses, as well as technologies that make its metaverse more immersive. Luxexcel has worked since 2009 to develop a more efficient way of mass-producing prescription lenses. Instead of relying on grinding and polishing, the Luxexcel platform builds lenses layer-by-layer in a material jetting process. The process also allows for the integration of smart technologies, in the form of waveguides or LCDs of films, into the lenses themselves.

Braskem to Expand 3D Printing Material Portfolio Through taulman3D Acquisition

Braskem, the largest petrochemical company in Latin America, acquired taulman3D, an American filament producer known for its creation of high-strength filaments and advanced thermoplastics for AM. The company is one of the leading producers of carbon fiber composite filaments. In 2021, they were awarded a NATO Stock Number, a code used by NATO to identify "standardized material items of supply" recognized by all member states, meaning that taulman3D's materials meet the necessary standards to be used to supply U.S. and NATO forces. Braskem's acquisition is a sign of its continued interest in the 3D printing sector. Through the acquisition, Braskem will be able to establish a foothold in the industrial 3D printing material market. Both companies are also committed to sustainability, with Braskem unveiling its three new sustainable 3D printing materials last year.

Academic

Researchers Create New Titanium Alloy with Use of 3D Printing

A team of researchers from Australia and Hong Kong created a new class of strong titanium alloys by integrating alloy and 3D printing process designs. The scientists believe the development could help extend the applications of titanium alloys, improve sustainability and drive innovative materials technologies. They see potential in aerospace, biomedical, chemical engineering, space and energy technologies. The new materials consist of a mixture of two forms of titanium crystals, alpha-titanium phase and beta-titanium phase, each corresponding to a specific arrangement of atoms.

New 3D Printing Technique Ready to Advance Manufacturing

Scientists from the Institute of Sensors, Signals & Systems at Heriot-Watt University in Edinburgh created a new method of 3D printing that uses near-infrared (NIR) light to create complex structures containing multiple materials and colors. They achieved this by modifying a well-established 3D printing process known as stereolithography to push the boundaries of multi-material integration. A conventional 3D printer would normally apply a blue or UV laser to a liquid resin that is then selectively solidified, layer by layer, to build a desired object, but a major drawback of this approach has been the limitations in intermixing materials. What is different about this latest project is that the scientists use a NIR light source capable of printing at far greater depths into the resin vat, and without the need to print in layers. The findings hold tremendous opportunities for industry, particularly those that rely on specialist parts such as in the health and electrical sectors.

Groundbreaking Project at Taubman College Involving Novel 3D Concrete Printing Method

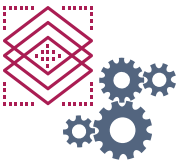
Architect Mania Aghaei Meibodi and researchers Alireza Bayramvand and Yuxin Lin of the DART Lab at the University of Michigan's Taubman College of Architecture and Urban Planning developed a method for creating ultra-lightweight, waste-free concrete. The method reduces weight by 72%, as compared to conventional, solid concrete of the same size, and is leading to new partnerships and patents beyond the university. While the most widely used approach on construction sites uses a planer toolpath, parallel to the ground or along a single plane, U-M's new approach called "Shell Wall" demonstrates a computational design and robotic 3D printing technology that effectively combines topology optimization with 3D concrete printing. The team created a computational model that combines nonplanar and variable material deposition based on the shape and geometric features of the topology-optimized parts. This allows for efficient use of material by placing it precisely where it's needed for structural purposes. With these technological advancements from the DART Lab researchers, notable leaders in 3D concrete construction—the Peri Group, ICON and WASP—are beginning to take notice.

U of T Researchers Advance Metal 3D Printing Technology for Automotive, Energy and Biomedical Applications

A team of University of Toronto (U of T) researchers is working to advance the field of metal additive manufacturing at the university's first metal 3D printing laboratory. The technology, which uses computer-aided design (CAD) to construct materials layer by layer, can improve manufacturing across aerospace, biomedical, energy and automotive industries. U of T's metal 3D printers are designed to specialize in both selective laser melting and directed energy deposition. For example, dental professionals can use selective laser melting to create dentures or implants customized to specific patients via a precise 3D model with dimensional accuracy within a few micrometers. Rapid prototyping also allows for easy adjustments of the denture design. Since building up the lab's metal printing capabilities, U of T has established partnerships with government research laboratories, including the National Research Council Canada and many Canadian companies, including Oetiker Limited, Mech Solutions Ltd., EXCO Engineering and Magna International.

MIT Researchers Develop Custom, 3D-Printed Heart Replica

MIT engineers have developed a procedure to 3D print a soft and flexible replica of a patient's heart. They can then control the replica's action to mimic that patient's blood-pumping ability. The procedure involves first converting medical images of a patient's heart into a three-dimensional computer model, which the researchers can 3D print using a polymer-based ink. The result is a soft, flexible shell in the exact shape of the patient's own heart. The team also uses this approach to print the patient's aorta. To mimic the heart's pumping action, the team fabricated sleeves like blood pressure cuffs that wrap around the printed heart and aorta. When the sleeve is connected to a pneumatic system, researchers tune the outflowing air to rhythmically inflate the sleeve's bubbles and contract the heart, mimicking its pumping action. This could allow doctors to print a patient's heart and aorta, then implant a variety of valves to see which results in the best function and fit, avoiding surgically implanting a synthetic valve to widen the aorta's natural valve. The researchers showed that each model heart could accurately recreate the same heart-pumping pressures and flows previously measured in each respective patient.



Material and Manufacturing

Used Coffee Pods can be Recycled to Produce Filaments for 3D Printing

An article published in the ACS Sustainable Chemistry & Engineering journal says plastic in used coffee pods can be recycled to make filaments for 3D printers, minimizing its environmental impact. The solution was successfully tested by researchers in Brazil at the Federal University of São Carlos (USFCar) and the State University of Campinas (UNICAMP) and in the United Kingdom at Manchester Metropolitan University (MMU). Researchers produced new conductive and non-conductive filaments from waste polylactic acid (PLA) from used pods. Most consumers throw used pods into the garbage bin, especially if they are made of plastic. Considering all the factors involved, calculations made by the São Paulo State Technological Research Institute (IPT) show that "a cup of pod coffee can be as much as 14 times more damaging to the environment than a cup of filter coffee." To develop uses for this waste, the researchers produced electrochemical cells with non-conductive filaments of PLA and electrochemical sensors with conductive filaments prepared by adding carbon black to the PLA.

New Resin for Industrial 3D Printing Suited for Mold Tooling

A new high-strength industrial resin developed by Henkel is purportedly well suited for 3D printing mold tooling and manufacturing aids. "Loctite 3D IND249 is a high-temperature, high-strength material that can print with fine feature resolution," said Henkel. Additionally, the resin offers low viscosity while still displaying high "green" strength, enabling high-accuracy printing and ease of processing. Validated workflows are already available for processing the resin on Nexa3D, Rapid Shape, and Stratasys printers.

Cheap, Fast Induction Tech Enables Unlimited-Size 3D Metal Printing

Arizona company Rosotics says it's ready to revolutionize large-scale 3D metal printing with a new "rapid induction printing" approach that can print parts of enormous size with advantages in speed, cost, safety and energy efficiency. Rosotics' founder and CEO Christian LaRosa says he's come up with an alternative that addresses issues with laser systems and opens the door for cheap, easy and fast printing of huge metal parts, big enough for structural use in aircraft and rockets. Rosotics has designed, built and tested a new type of metal 3D printing head, called the Mantis, that delivers heat to the metal highly efficiently through induction, opening the process up to a wide range of metals. The company has tested extensively with steel and aluminum thus far, but Rosotics says it should be able to handle most metals. The printer currently uses wires between 1-10 mm in diameter but can scale upwards if necessary simply by widening the nozzles. In addition, the RIP process is claimed to make the entire process much faster and cheaper, opening metal printing up to a virtually limitless scale. Rosotics opened its manufacturing service for qualified customers starting in October 2023. The company has also announced that its production campus will be at Falcon Field Airport in Mesa, Arizona.

Max Planck and Heidelberg Researchers Explore Touchless 3D Printing Using Acoustic Holograms

The Max Planck Institute for Medical Research and Heidelberg University published a new study in the Journal of Advanced Sciences. The study shows multiple acoustic holograms making pressure fields that can be used to 3D print solid particles, gel beads, and even living cells. The researchers hope the study opens up new possibilities in areas like biomedicine by highlighting the potential of ultrasound-based 3D printing technology for assembling biological cells, as it is gentle and non-toxic to cells. The non-contact remote assembly feature also helps maintain sterility, which can keep cells healthy. In addition, the research introduces a new method of creating precise 3D shapes using multiple "acoustic holograms," which resemble sound blueprints. The team tested the process by combining tiny particles and cells into specific shapes faster than traditional 3D printing. This technology can be used with various materials and may have medical applications, such as drug delivery and tissue engineering. Despite the technology's limitations, such as being constrained by the power of sound waves and requiring materials that can resist gravity, the new 3D printing method represents a "promising step forward" in sound wave-based 3D fabrication.

Construction

Developer Completes World's Largest 3D-Printed Building in Florida

Printed Farms completed the world's largest 3D-printed building, a luxury horse barn, in Wellington in Southern Florida. Printed Farms used COBOD's BOD2 construction 3D printer for the job. The building has been constructed to withstand extreme local weather conditions including hurricanes and tropical storms. The versatility and benefits of 3D printing technology are also demonstrated through the structure's 3D-printed walls that create a cavity and air gap, providing natural cooling to the building. The build process involved five moves of the printer with the two sides completed twice and the middle section executed once.

China to Explore 3D Printing on Moon to Build Habitats

The China National Space Administration announced it would conduct on-site investigations of the lunar soil's environment and mineral composition to use 3D printing technology to construct buildings on the moon. China will launch the Chang'e 6, 7, and 8 missions, with 8 being tasked to look for reusable resources on the moon for long-term human habitation. China has plans to start building a lunar base using soil from the moon in five years. The Chang'e 8 mission will include a robot tasked with making lunar soil bricks.

World's First 3D-Printed Hotel to Open in 2024

The world's first 3D-printed hotel will open in Texas in 2024 and will showcase cutting-edge architectural approaches made possible by large-scale 3D printing. The project is rebuilding, relocating, and expanding the El Cosmico hotel and will integrate El Cosmico's existing infrastructure with new facilities and amenities. The property will also include a community of two-, three-, and four-bedroom 3D-printed homes for purchase as private vacation residences. The hotel is a joint venture between Liz Lambert's team, ICON, and BIG (Bjarke Ingels Group).

India's First Prototype Bridge Using 3D Concrete Printing Tech Developed by IIT-H, Simpliforge

A prototype 3D printed bridge has been developed and printed as part of a collaboration between the Indian Institute of Technology, Hyderabad (IIT-H) and Simpliforge Creations. IIT-H civil engineering professor K.V.L. Subramaniam and his research group developed and evaluated the concept and design. The bridge was printed by Simpliforge, a startup company specializing in providing 3D concrete printing solutions. Designed as a pedestrian bridge, the prototype model is undergoing load testing and evaluation for practical use at Siddipet. Simpliforge Creations developed an extrusion and software system specifically for the project to exhibit its 3D printing system's merits fully. Using the Industrial robotic arm 3D printer, the bridge was printed off-site in under two hours at the Simpliforge Printing facility and assembled on-site.

3D Printing Reaches New Heights with Two-Story Home

A two-year collaboration by Hannah, Peri 3D Construction, and Cive is creating what is believed to be the first 3D-printed, two-story home in the U.S. Construction will take 330 hours of printing. The three-bedroom home with wooden framing is about halfway finished. Cive's head of structural engineering hopes the innovative technology can one day help more quickly and cheaply build multifamily dwellings.

World's First 3D Printed Mosque to be Built in Dubai

Dubai's Islamic Affairs and Charitable Activities Department (IACAD) is set to build the world's first 3D-printed mosque in Bur Dubai. The 2,000-square-metre mosque is expected to open its doors in 2025 with space for up to 600 worshippers. Initially expected to cost more than traditional construction techniques, 3D printing expenses are expected to decrease in the coming years. Dubai's plans for a 3D-printed mosque have been introduced by the IACAD, a department dedicated to charitable work. According to the organization, two of its core five objectives focus on mosque sustainability and Islamic leadership, and its latest infrastructure project represents a step towards both of these goals. Construction will begin in October 2023 from a mixture of raw materials and specially formulated concrete. The technology used to carry out the build will "reduce construction material waste" and make it more sustainable. The project will also involve the operation of a "robotic 3D printer," which enables the deposition of materials at a pace of two square meters an hour by three workers at a time. The mosque is anticipated to take four months to build and another 12 months to install the facilities needed. The IACAD is coordinating with local Dubai Municipality authorities to get final approval for its design.

Food

Scientists 3D Printed a Slice of Cake

NPJ Science of Food journal reported that a team at Columbia University used a 3D printer to make an edible slice of cake. The technology built the slice by squeezing each element out of a syringe in thin lines, forming the layered dessert. In the future, people might be able to buy 3D printers for cooking in their homes, but the price could run up to $1,500, and they would need recipes to function. Likening it to an mp3 player without any mp3 files, researchers say there will be a need for a source for users to download recipes, create their own, and get inspiration. While experts don't foresee such devices in homes, they could become helpful in restaurants and cafeterias, said a philosopher of technology who did not contribute to the research.

Neutrogena Unveils New Custom 3D Printed Dietary Supplements

Neutrogena has introduced a line of personal 3D-printed skin health supplement gummies. The company says users can create Skin360 SkinStacks using data collected via its digital skin assessment tools. Once users have completed the self-scan, they can order their 28-day supply of gummies from 3D printing specialist Nourished, with each layer containing nutrients designed to address a particular area of skin concern. The technology behind Skin360 SkinStacks was developed by Nourished, revolving around a proprietary nutrient-producing technology allowing customers to create custom supplements from up to seven of 28 ingredients. In addition, the Neutrogena Skin360 app enables users to take a 180-degree selfie and uses a proprietary algorithm to assess the skin and recommend a nutrient plan. Users are being offered five different skin goals at launch.

Health

Stratasys and Collplant Joint Development Addresses $2.6B Bioprinting Market Opportunity

Stratasys and CollPlant have signed a cooperative development and commercialization agreement to establish a method for bio-fabricating human tissues and organs utilizing CollPlant Biotechnologies' rh-Collagen-based bio-inks and Stratasys Ltd's P3 technology-based bioprinter. The first project focuses on making a solution for CollPlant's program for regenerative breast implants that can be used on an industrial scale. Technologies and solutions based on CollPlant's plant-based collagen are being developed for tissue regeneration and organ production. The new bioprinter will make it possible to print CollPlant's cutting-edge breast implants, designed so that a person's natural breast tissue can grow back without triggering an immune response, a ground-breaking alternative for aesthetic and reconstructive procedures. In addition, according to the agreement, both businesses will cross-promote each other's bioprinting goods.

Australian Engineers Create 'Flexible Robot' for 3D Printing Inside the Body

A team of biomedical engineers at the University of New South Wales in Australia have developed a small flexible robot that can be used to 3D print biomaterials directly inside the human body. Currently, biomaterials must be created outside of the body before relying on typically invasive surgery to insert the materials inside the body, but researchers say this new device will eliminate complications and risks by printing directly inside the body. The device features a three-axis printing head that can bend and twist using hydraulics on the tip of a soft robotic arm. The nozzle can print pre-programmed shapes or be operated manually if more complex or undetermined printing is required. The smallest prototype has a diameter of approximately 11-13 millimeters, but it could be scaled even smaller in the future. The engineers believe the device is on track for commercialization in the next five to seven years, pending further clinical trials.

Weill Cornell Researchers Develop Effective Breast Reconstruction Process Using 3D Printing

The Laboratory of Bioregenerative Medicine and Surgery at Weill Cornell Medicine published a study that described a newly developed breast reconstruction technique utilizing a 3D-printed scaffold. It aims to achieve softer, more natural and higher quality reconstructed nipples for breast cancer patients after mastectomies. First, the lab 3D printed a scaffold into the shape of a nipple using a biodegradable material known as Poly-4-Hydroxybutyrate or P4HB, collaborating with Tepha, Inc., a company that creates P4HB for use in surgical meshes and medical devices. The scaffold was then used to reconstruct the nipple and covered with skin flaps. During the first three to six months after the surgery, the scaffold maintains its shape and resists the skin contraction that typically shrinks the nipple with current solutions. The scaffold then begins to degrade, allowing the body to replace it with local tissue, and once the wound is fully healed and the scaffold has degraded, less skin contraction occurs, allowing for the reconstructed nipple to be softer, like a natural nipple. The research confirmed that the P4HB of the scaffold was eventually replaced by healthy soft tissue, and that the lab's newly developed breast reconstruction method will provide breast cancer patients with optimal reconstructed nipples. Additionally, the new method addresses patient concerns in other areas, such as aesthetics and safety. The lab is continuing to further develop their scaffold design in a way that allows them to control the degradation rate of the scaffold. Ideally, the scaffold should break down slowly during the first three to six months after surgery and then increase its degradation rate afterward. The research team hopes to continue to improve the 3D-printed P4HB scaffold to develop it into a strong candidate in the nipple reconstruction field.

Aerospace, Defense & Military

NASA 3D Printeds Superalloy

A team of researchers from NASA and The Ohio State University detailed the characteristics of the new alloy, GRX-810, that could lead to stronger, more durable parts for airplanes and spacecraft. The team employed time-saving computer modeling and a laser 3D printing process that fused metals, layer by layer, to create the new alloy. GRX-810 is an oxide dispersion-strengthened alloy, meaning tiny particles containing oxygen atoms spread throughout the alloy enhance its strength. Such alloys can withstand harsher conditions before reaching their breaking points. For example, current state-of-the-art 3D printed superalloys can withstand temperatures up to 2,000 degrees Fahrenheit. Compared to those, GRX-810 is twice as strong, over 1,000 times more durable, and twice as resistant to oxidation.

Relativity Space's Terran 1 Launches, Achieves Structural Viability

California-based aerospace startup Relativity Space attempted to launch the world's first 3D-printed rock, Terran 1. In its third launch attempt, the booster took off from Florida's Cape Canaveral Space Force Station but failed to reach orbit and ultimately crashed into the Atlantic Ocean. The mission was a significant achievement for Relativity Space as the two-stage Terran 1 rocket was composed of about 85% 3D printed materials by mass, and the company plans to increase this percentage to 95% for upcoming vehicles. Terran 1 established itself as the first almost entirely 3D printed rocket to successfully fly and pass crucial stages, such as Max-Q, main engine cut-off, and second stage separation. All of the engines, along with the rocket's structure, have been created using Relativity Space's proprietary 3D printing process, which enabled the creation of algorithmically generated and optimized structures. The manufacturing process, driven by software and data, relies on foreign 3D printed materials and new design geometries previously impossible with traditional manufacturing techniques.

Ministry of Defence Teams Up With Industry for 3D Printing

The Ministry of Defence (MOD) has taken the first steps in exploring the issues preventing the full utilization of 3D printing. The MOD has set up the first framework and has awarded industry contracts to five companies – AMFG, Babcock, NP Aerospace, RBSL, and Thales. These companies will tackle the first phase of this work, which is focused on fitting 11 non-safety critical metallic parts onto in-service platforms. The companies will work closely with the MOD and other industry organizations to scale up the use of 3D-printed parts, leading to more significant innovation in manufacturing. Under this first step of the framework, the MOD will work with the industry on tasks of increasing complexity; all focused on additively manufactured defense inventory parts to fit these to in-service platforms. If successful, this will enable the UK to exploit the technology better and be prepared for future requirements.

NASA Awards Advance 3D Printing, Quantum Tech for Climate Research

NASA announced it will create two new institutes to develop technology in critical engineering and climate research areas. Two new Space Technology Research Institutes (STRIs) will leverage teams led by U.S. universities to create multidisciplinary research and technology development programs critical to NASA's future. One of the research institutes will focus on quantum sensing technology supporting climate research. The other will work to improve understanding and help enable rapid certification of metal parts created using advanced manufacturing techniques. For example, a NASA project called Long Life Additive Manufacturing Assembly (LLAMA) is 3D printing methods for building rocket engine components. In addition, a new NASA Space Technology Research Institute will develop advanced computer models to help engineers better understand and validate the characteristics of additively manufactured metal parts for use in spaceflight. Metal parts 3D-printed are made from powdered metals, which are melted in specific ways and shaped into functional parts. However, efficient certification and use of such parts require high-accuracy predictions of their characteristics. Detailed computer models, known as digital twins, will allow engineers to understand the parts' capabilities and limitations, and such models will provide the predictability of part properties based on their processing.

US Army Opens New Horizons with 3D Printing for Vehicle Parts

The US Army will open an Advanced Manufacturing Commercialization Center dedicated to producing large parts for various ground vehicles to reduce logistics supply chain timelines and accelerate maintenance processes. The new facility dedicated to 3D printing and exploring new additive manufacturing options opened in April. Located in Sterling Heights, Michigan, the Advanced Manufacturing Commercialization Center (AMCC) will produce large parts for various ground vehicles and allow for a more efficient process by reducing weight, lowering costs and improving long-term sustainment efforts. AMCC will also enable the Tank-Automotive & Armaments Command and the Ground Vehicle Systems Center, which is part of the Combat Capabilities Development Command.

U.S. Navy Installs First Onboard Metal 3D Printing System

Meltio and Phillips Corp. worked together to install a metal 3D printing system for the onboard manufacture of spare parts and repairs onboard a U.S. Navy ship. The Phillips Additive Hybrid system, which integrates Meltio's laser metal deposition head with a Haas TM-1 CNC mill, is being used on the USS Bataan. The system prints 316L stainless steel, a prevalent material in U.S. Navy ship systems. While stainless steel additive manufacturing onboard naval ships is new, it also represents an advancement in providing sailors with industrial-level manufacturing capabilities to print individual parts for systems that previously have not been readily available without procuring the entire system at a significantly greater cost. As a result, it maximizes operational availability and reduces the demand on traditional and Navy-specific supply chains.

Energy

New 3D Printing Process Offers Novel Energy Storage Design Options

UNSW engineers have developed a process to print solid-state polymer electrolytes into any shape desired for use in energy storage. The research team from the School of Chemical Engineering say the 3D printing process of such material could be particularly useful in future medical devices where small, intricately designed energy storage offers several benefits.