Desktop Metal

CASE STUDY

Theoretical Binder Jet Additive Manufacturing Research

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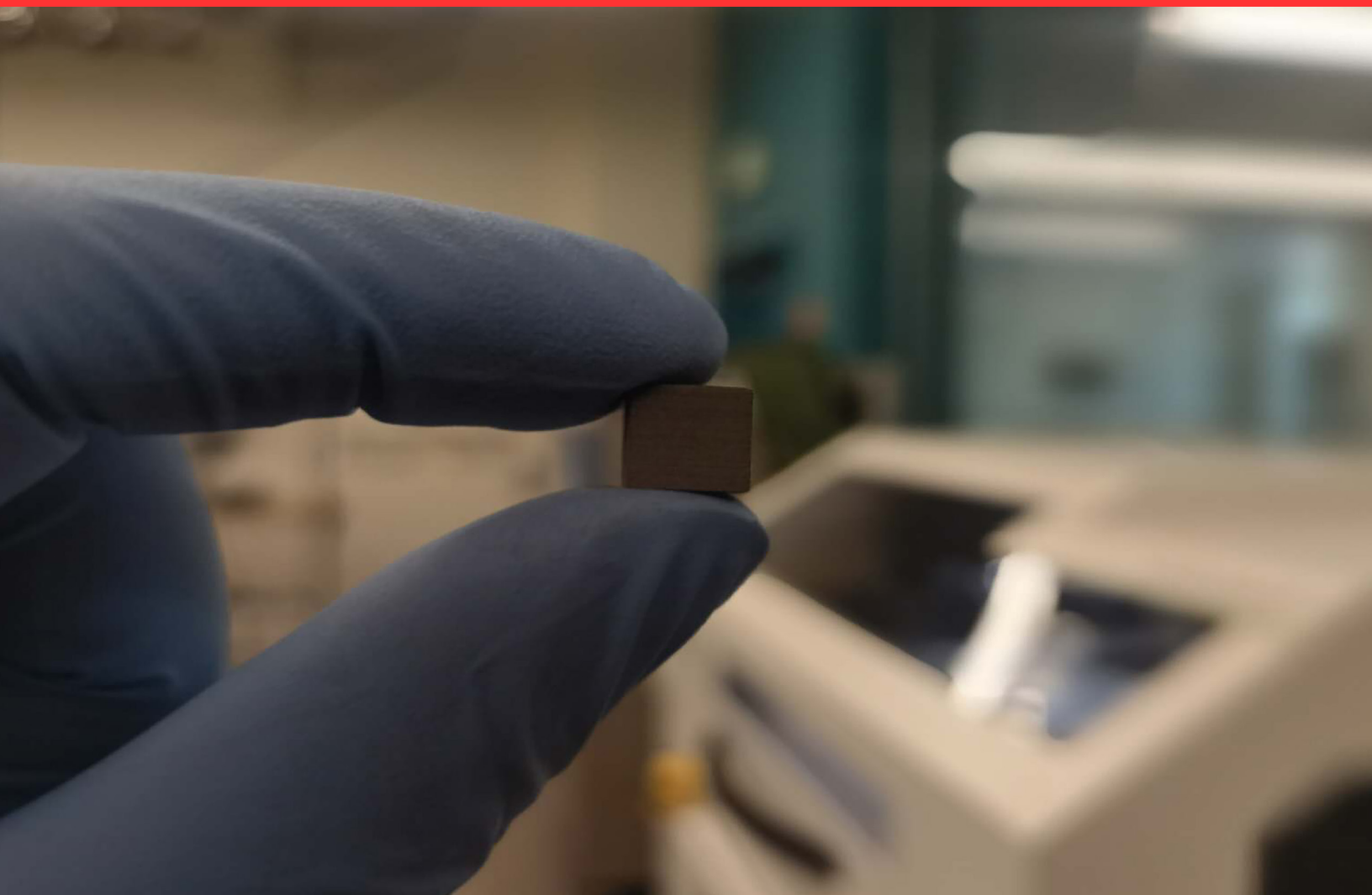
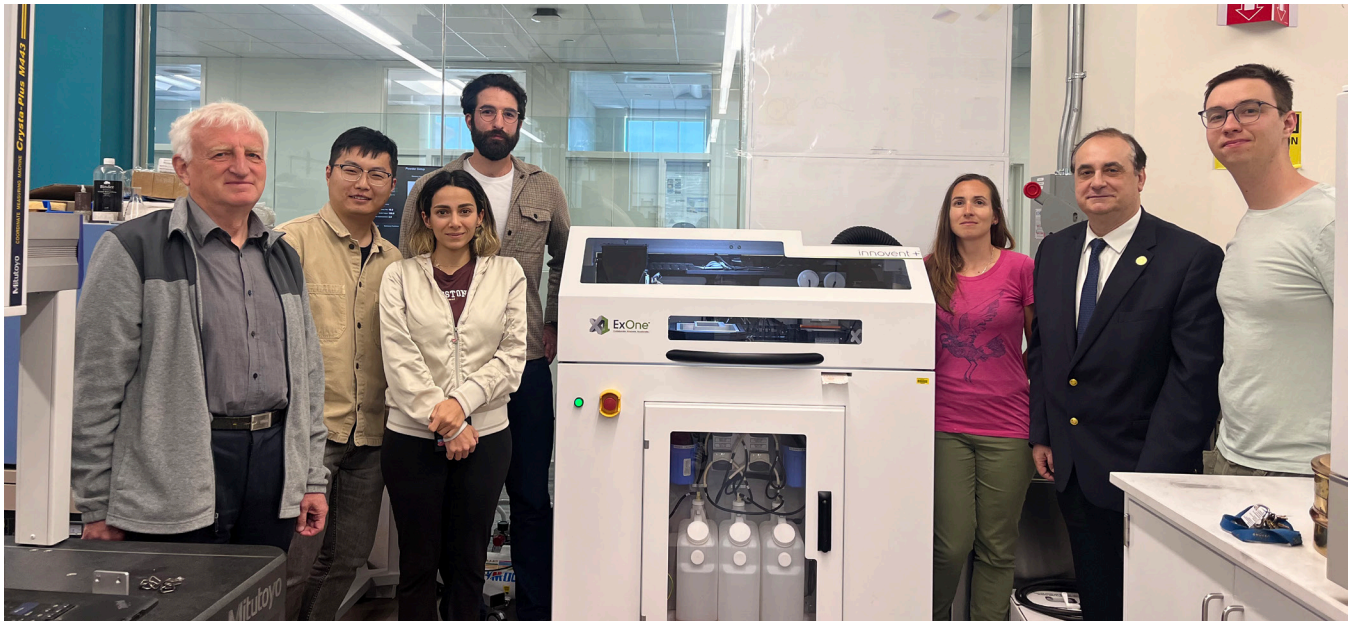
San Diego State University studies 3D printed anisotropic microstructures with the InnoventX





Customer
The Powder Technology Laboratory at San Diego State University

Location
San Diego, California

Industry
Education and research

Application
Theoretical process research

Machine
InnoventX

Website
www.ptl.sdsu.edu

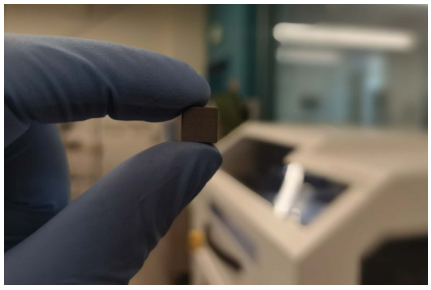
Exploring fundamental understandings of sinter-based AM

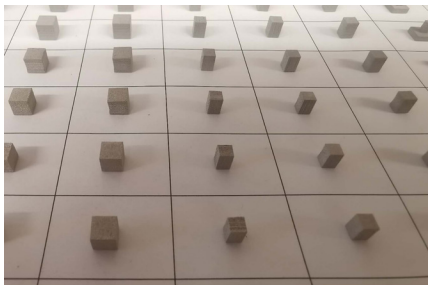
Within additive manufacturing, binder jet 3D printing stands out because of unique advantages like its material flexibility as well as being a thermally neutral build process, two benefits that aren't unrelated. Recently, San Diego State University (SDSU) invested in a Desktop Metal InnoventX 3D printer for the theoretical study of the binder jetting process and the anisotropic microstructure of the resulting prints.

Directed by Dr. Eugene Olevsky and Dr. Elisa Torresani, The Powder Technology Laboratory (PTL) at SDSU is a world-leading center in sintering research. Projects at the lab explore fundamental understandings on sintering assisted additive manufacturing as researchers conduct experimentation and simulation on novel alloys with cutting-edge technologies.

Runjian Jiang is a PhD student in the University of California and San Diego State University joint doctoral program in Mechanical & Aerospace Engineering and a PTL researcher at the College of Engineering. He focuses on additive manufacturing, especially the binder jetting of metal and alloy materials.

As a theoretical researcher, Jiang is focused on the process itself and studying the anisotropic properties of the material at different stages of the workflow. "Binder jetting is the 3D construction and we want to understand the anisotropic microstructure and how it changes during sintering," he said.





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Stainless steel structures are binder jet 3D printed on the InnoventX, top. Above, a group of printed 316L stainless steel parts after different sintering stages display the anisotropic evolution during the sintering.

During the binder jetting process, liquid binder is deposited onto the powder bed layer-by-layer to build complex geometries. Unlike laser or electron-beam processes that introduce heat to fuse the powder during the build, binder jetting simply "glues" the particles together before final densification in a sintering furnace. Because this is done without an energy source such as a laser melting the shape together, binder jet technology produces parts with anisotropic properties. This is particularly important in industries where strength and consistency are critical, such as the aerospace, automotive, and medical sectors.

Jiang explains his research to lay the groundwork for a theoretical understanding of the binder jetting process. "We want to understand how a part is reconstructed as a 3D structure because it's anisotropic during the binder jetting process and it's changed during sintering." Using Computed Tomography (CT) scanning he studies printed and sintered material.

"We investigate not only porosity itself, but also porosity distribution in different positions," Jiang emphasized. "And then we get more detailed, more specific, and investigate more details like how particles are orientated with each other, packed together."

Easy-to-produce precision results

Installed in 2024, the InnoventX at the Powder Technology Laboratory was upgraded with an ultrasonic recoater capable of working with a wider range of powders and simplifies powder change over. As the most researched binder jetting machine on the market, the InnoventX prints fine features and top-quality surface finishes on an easy-to-use open-material system.

For the start of the project, the lab is currently processing the most established stainless steel materials. Jiang explained, "It should be something very simple for the theoretical study so we can study the process itself."

The team starts with the provided base parameters and Jiang states it takes minimal trial and error to get the desired outcome. "It's easy to correlate the process parameters with the final results," he said. Otherwise, adopting the binder jetting workflow was easy for the facility. Jiang explains he simply has to construct and upload the STL file then follow the step-by-step instructions that create a standard procedure. "After I start a build, I might stand there and check for a while but then I can leave it. It's all automatic, that's the thing I love about it."

The compact footprint of the smallest binder jetting system in the X-Series makes it easy for the team to operate the platform while providing top-

quality prints for the research at hand. “With the InventX I can print a sample less than one millimeter, and that‘s very important for me,” Jiang emphasized. “I need to scan the 3D structure of the samples with the x-ray CT, so I need very small samples, the smaller the better, and the Desktop Metal binder jetting machine can give me this good result.”

While he is just at the beginning of his research, Jiang is excited to establish a scientific understanding of the microstructural evolution of materials produced by binder jet 3D printing and sintering. Fundamentally understanding this technology‘s capabilities could lead to innovations in material science and engineering that impact applications in various industries. And as a flexible technology with the ability to process metals, composites, and ceramics, Jiang sees a future with the InventX that could include studies on more functional and structural materials.

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>
> Runjian Jiang, PhD student and a PTL researcher, San Diego State University

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About Desktop Metal Inc.

Desktop Metal (NYSE:DM) is driving Additive Manufacturing 2.0, a new era of on-demand, digital mass production of industrial, medical, and consumer products. Our innovative 3D printers, materials, and software deliver the speed, cost, and part quality required for this transformation. We’re the original inventors and world leaders of the 3D printing methods we believe will empower this shift, binder jetting and digital light processing. Today, our systems print metal, polymer, sand and other ceramics, as well as foam and recycled wood. Manufacturers use our technology worldwide to save time and money, reduce waste, increase flexibility, and produce designs that solve the world’s toughest problems and enable once-impossible innovations. Learn more about Desktop Metal and our #TeamDM brands at www.desktopmetal.com