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Method and Device for Rapid Prototyping and Material Processing

AzTE Case #96-030

Background

Manufacturing processes utilizing deposition techniques have been developed for rapid and flexible prototyping of three-dimensional parts and tooling. Metals are typically deposited on a surface through thermal spray or weld deposition techniques. A newer technique, drop generation, deposits liquid metal from a nozzle onto the substrate. However, the range of droplet sizes which can be created is small, limiting the speed and capabilities of drop generation prototyping machines.

Invention Description

Researchers at Arizona State University have developed a novel method and apparatus for drop generation manufacturing which addresses current needs. Inside an environment-controlled chamber, the system uses a continuously variable diameter nozzle or controllable planar jet to achieve a wide range of droplet sizes. Using acoustic energy, the metal flow is broken up into droplets and deposited on the substrate in a high-speed, reliable manner. With this system, three-dimensional objects of all types can be rapidly and reliably created. The substantial increases in speed offered by this system allow droplet generation to expand beyond rapid prototyping into true manufacturing.

Potential Applications

- Rapid Prototyping
- General Freeform Fabrication
- Materials Processing

Benefits and Advantages

- **Variable Droplet Size** – Allows for faster mass flux when desired, and more controlled flux when desired, leading to faster, more accurate structure generation.
- **Minimized Manufacturing Defects** – Fine, equiaxed microstructures free of porosity or alloy segregation can be constructed.
- **No Post-Processing** – The structures created with this technology do not require time-consuming and expensive post-processing treatments.
- **Complex Geometry Compatible** – The system allows for a low-melting point support material to be deposited along with the molten metal. This material provides support for the metal layers until construction is completed, after which it can be easily removed.

Development

This technology is part of a suite of rapid prototyping technologies developed at Arizona State University. A first-generation droplet generator has been constructed, and research results have been published.

Inventors

Dr. Ampere Tseng

Professor

Department of Mechanical and Aerospace Engineering, Arizona State University

Dr. Tae-Woo Lee

Former Assistant Professor

Department of Mechanical and Aerospace Engineering, Arizona State University

Intellectual Property Status:

U.S. Patents: 6,216,765
6,309,711

Contact

Bill Loux

Director of Business Development

Arizona Technology Enterprises, LLC (AzTE)

480.884.1996 main

480.884.1992 desk

Email: bloux@azte.com