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Office of Technology Management - The Pennsylvania State Univ.
113 Technology Center, University Park, PA 16802
814.865.6277 phone; 814.865.3591 fax

Non-Confidential Description - PSU No. 4641
"Friction Stir Additive Manufacturing Billet and Tube Production"

Keywords:

Advanced Manufacturing, additive manufacturing, friction stir

Links:

Inventor Webpage: <http://behrend.psu.edu/person/chetan-nikhare-phd>

Inventors:

Chetan Nikhare, Glenn Craig

Background

In additive manufacturing, a workpiece is created by building layers of material. The layers can be created by locally welding the material at a desired location. The material can be used in the form of powder, pellets, wire, sheet, plates, etc. One way the welding of a material can be achieved is by a friction stir process, in which a solid tool rotates to weld, repair or modify the geometry of a material. While conventional additive manufacturing systems produce a workpiece by relying on various processes that include forming layers of build material to a base build material, these processes often restrict the range of mechanical properties exhibited in a workpiece. As a result, the limited properties of the material hinders the use of many additive manufacturing systems. The described invention addresses these limitations by improving the ability to maintain a workpiece's mechanical properties throughout the manufacturing process.

Invention Description

The disclosed invention includes systems and methods that relate to friction stir techniques and/or a substitute to friction stir techniques to perform additive manufacturing for a workpiece. The invention includes systems and methods for additive manufacturing of a workpiece, a workpiece from a build material, a workpiece by adding a build material in a sequence of add-layers, and a workpiece from a base of build material without adding a build material in layers. The invention allows for the introduction of a build material into a die, thereby allowing the performance of work on the build material via a friction and pressurizing process to generate the work piece. Furthermore, a punch (e.g., friction stir tool or friction stir head) may be inserted into the die and used to plasticize the material.

For example, a desired width billet can be manufactured by, first, placing material powder into a die. The punch with the desired rotation as well as with a desired axial feed stirs and compresses the powder. With the stir-compression process, the powder can reach its semi solid state and thus bonding between particles can be achieved. As a result, the desired billet can be created. Because the process combines the green compact and sintering processes, the product maintains better mechanical properties than alternative methods of manufacture.

The invention allows for various shapes and sizes of a workpiece to be formed. For example, the invention includes systems and methods that can be used to generate a workpiece in the form of a blank, a billet, a tube, etc. Therefore, the invention may be particularly applicable in the architecture, aerospace, automotive, furniture, and jewelry industries where novel structures are needed to be manufactured.

Advantages/Applications

- Maintains a workpiece's mechanical properties through the manufacturing process
- Various shapes and size of a workpiece can be formed

IP Status: U.S. provisional application filed on October 5, 2017.

Contact: David Sadowski
Sr. Technology Licensing Officer
The Pennsylvania State University

Phone: (814) 863-7070

Fax: (814) 865-3591

E-mail: drs47@psu.edu

{DATE}>JAN 26