Manufacturing

Novel Overhang Support Designs for Powder-Based Electron Beam Additive Manufacturing (EBAM)

Enables the production of higher quality, less expensive parts via additive manufacturing

NASA Marshall Space Flight Center, in collaboration with the University of Alabama, has developed a contact-free support structure used to fabricate overhang-type geometries via EBAM. The support structure is used for 3-D metal-printed components for the aerospace, automotive, biomedical and other industries. Current techniques use support structures to address deformation challenges inherent in 3-D metal printing. However, these structures (overhangs) are bonded to the component and need to be removed in post-processing using a mechanical tool. This new technology improves the overhang support structure design for components by eliminating associated geometric defects and post-processing requirements.

BENEFITS

- Simplifies production of complex design architecture by reducing or eliminating the required support structure traditionally required by EBAM technology
- Eliminates geometric deformation associated with overhangs during fabrication process
- Removes post-processing requirements associated with overhangs
- Significantly improves product quality and function
- Requires less material than existing techniques

technology solution

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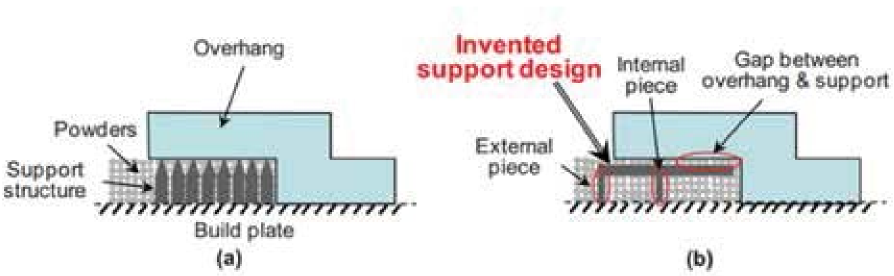
THE TECHNOLOGY

EBAM technology is capable of making full-density, functional metallic components for numerous engineering applications; the technology is particularly advantageous in the aerospace, automotive, and biomedical industries where high-value, low-volume, custom-design productions are required. A key challenge in EBAM is overcoming deformation of overhangs that are the result of severe thermal gradients generated by the poor thermal conductivity of metallic powders used in the fabrication process. Conventional support structures (Figure 1a) address the deformation challenge; however, they are bonded to the component and need to be removed in post-processing using a mechanical tool. This process is laborious, time consuming, and degrades the surface quality of the product.

The invented support design (Figure 1b) fabricates a support underneath an overhang by building the support up from the build plate and placing a support surface underneath an overhang with a certain gap (no contact with overhang). The technology deposits one or more layers of un-melted metallic powder in an elongate gap between an upper horizontal surface of the support structure and a lower surface of the overhang geometry. The support structure acts as a heat sink to enhance heat transfer and reduce the temperature and thermal gradients. Because the support structure is not connected to the part, the support structure can be removed freely without any post-processing step.

Future work will compare experimental data with simulation results in order to validate process models as well as to study process parameter effects on the thermal characteristics of the EBAM process.



Simplified comparison between (a) conventional supports and (b) invented support design

APPLICATIONS

The technology has several potential applications:

Consumer products/ electronics – tools and manufacturing equipment such as grippers; embedded electronics, e.g. RFID devices

Aerospace – lightweight parts with complex geometry, e.g. fuel nozzles

Automotive – special components for motorsports sector, e.g. cooling ducts

Biomedical – orthopedic implants

Tools/Molds – manufacturing inserts and tools/molds with cooling channels; direct tooling and indirect tooling

PUBLICATIONS

Patent Pending

More Information

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