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Laser Engineered Net Shaping for Direct Fabrication of Metal Components

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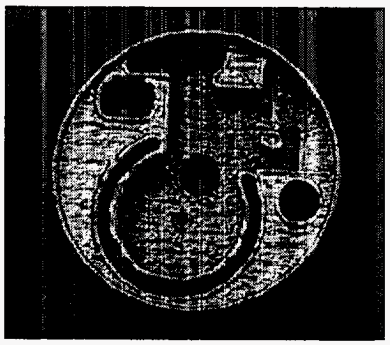
Sandia National Laboratories is developing a new technology to fabricate three-dimensional metallic components directly from CAD solid models. This process, called Laser Engineered Net Shaping (LENS™), exhibits enormous potential to revolutionize the way in which metal parts, such as complex prototypes, tooling, and small-lot production parts, are produced.

To perform the process, metal powder is injected into a molten pool created by a focused, high-powered laser beam. Simultaneously, the substrate on which the deposition is occurring is scanned under the beam/powder interaction zone to fabricate the desired cross-sectional geometry. Consecutive layers are sequentially deposited, thereby producing a three-dimensional metal component.



Solid LENS™ component fabricated from 316 stainless steel. Diameter = 1.5 inch.

This process is similar to other rapid prototyping technologies in its approach to fabricate a solid component by layer additive methods. However, LENS™ technology is unique in that fully dense metal components are fabricated directly from raw materials, thereby eliminating intermediate processing steps. LENS™ technology offers the opportunity to reduce dramatically the time and cost required to realize functional metal parts. As an example, an initial industrial application of the LENS™ process to produce injection molding dies resulted in a savings of over 50% in time and cost compared with conventional methods.

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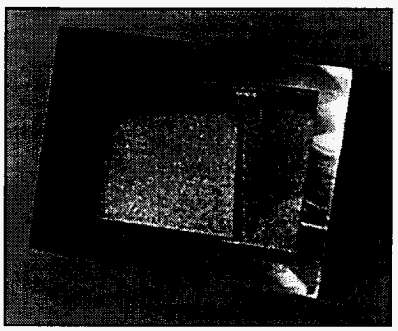

LENS™ fabricated injection molding die. Surface finished with EDM

Additional benefits are anticipated in the fabrication of hardware with complex features, conformal cooling channels, and production of functionally gradient structures composed of multiple materials. As a material additive process, additional costs savings will be realized through increased material utilization as compared to bulk removal processes. LENS™ technology can also be used to modify or repair existing hardware.

Parts have been fabricated from 316 stainless steel, nickel-based alloys, H13 tool steel, tungsten, and titanium carbide cermet. Microscopy studies show the LENS™ parts to be fully dense with no compositional degradation. Testing of several structural metal alloys reveals outstanding mechanical properties in as-fabricated parts.

- As-fabricated 316 stainless steel mechanical properties: ultimate tensile strength = 100 ksi, elongation = 30%.
- As-fabricated H13 tool steel properties: Hardness = 59.3 R_c

Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the United States Department of Energy under Contract DE-A04-94AL85000.

DISCLAIMER

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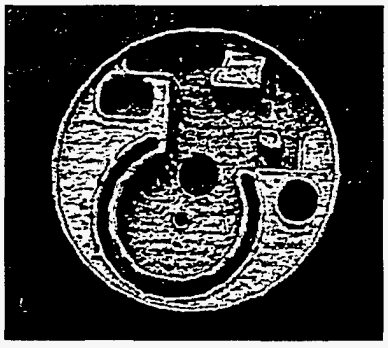

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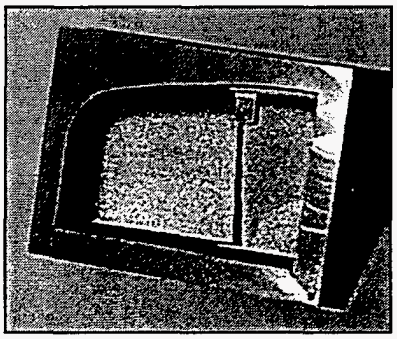

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