Sandia National Laboratories

by Shawn Dirk

Sandia National Laboratories is a multimission laboratory managed by National Technology & Engineering Solutions of Sandia, LLC a wholly owned subsidiary of Honeywell International, Inc., for the U.S. Department of Energy's National Nuclear Security Administration. Sandia has a long history of pioneering AM technology development. In the mid 1990s, Sandia developed laser-engineered net shaping (LENS), one of the first direct metal AM technologies, which was commercialized by Optomec. Robocast, an extrusion-based direct-write process for 3D ceramic parts, is another technology developed at Sandia. It was commercialized by Robocast Enterprises, LLC. As of January, 2019, Sandia was conducting AM R&D projects valued at about $25 million, with an emphasis on: 1) analysis-driven design, 2) materials reliability, and 3) multi-material AM.

Traditional CAD software is poorly suited to taking advantage of the geometric freedom enabled by AM. To address this issue, Sandia is developing a multi-physics, engineering-analysis-driven design software tool for AM, known as PLATO. When using the software, the designer specifies requirements and priorities for different design objectives. The software then creates optimized design alternatives. PLATO can handle multiple materials in a single part, and a future goal is to also optimize based on manufacturing constraints. PLATO's user interface is much like traditional CAD, but the software uses powerful underlying engineering code and meshing tools. PLATO is available through a government use license.

Compared to wrought metals, parts made by metal AM may exhibit greater variability in properties and performance. Sandia is using sophisticated experimental and computational tools to develop foundational processing-microstructure-property-performance relationships for AM metals. The work is based on extensive prior experience with related process technologies, such as laser welding and thermal spraying. Understanding these relationships will enable Sandia to identify and control important sources of variability in AM metals. The goal is to control the process so that parts can be built with quantified margins and uncertainties, a concept known as "born qualified."

The ability to generate and print custom AM materials will enable many new applications. Thus, Sandia is developing custom feedstocks for direct-write based multi-material printing, as well as high entropy alloys with unique properties. Sandia has also developed capabilities in wire-feed additive to address larger part scales and alleviate safety concerns with powder feedstocks

Sandia have developed an automated, high-throughput tensile testing system, which has generated interest in the AM community. It is 100 times faster and far less expensive than traditional tensile testing methods. It can pull roughly 100 AM tensile bars per hour to obtain statistically useful property distributions.

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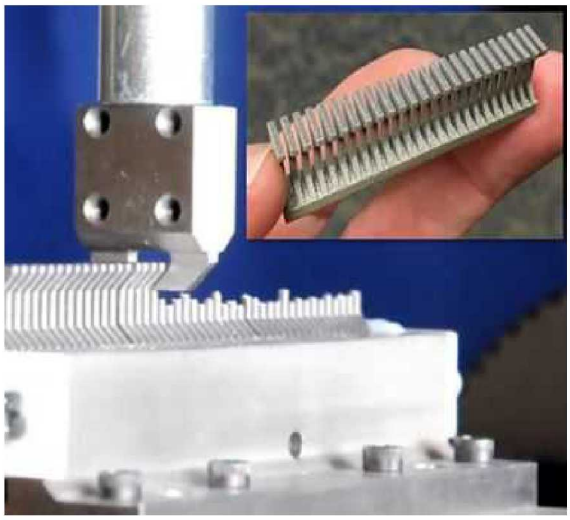

Automated high-throughput tensile testing system, courtesy of Sandia National Laboratories