New imaging technique helping scientists to visualize future 3D printing technology

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Lead Institution Name:	Louisiana State University
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What is the outcome or accomplishment? (1-2 short sentences describing it and why it is transformative; 50 word max. suggested)*

Neutron interferometry, a non-invasive imaging method, has been developed as a tool to detect early crack formation in parts manufactured with Selective Laser Melting (SLM) technology.

This research has contributed to the successful funding of a new interferometry beamline at Oak Ridge National Laboratory, adding to the nation's infrastructure for advanced manufacturing research.

What is the impact? (1-2 simple sentences describing the benefits for science, industry, society, the economy, national security, *etc.*; suggested 50 word maximum)

While this new technology is under rapid development, the science of the materials and their interactions with the manufacturing processes are not yet fully understood. Due to the complexity of the highly dynamic SLM process, the parts can contain defects, which could lead to poor mechanical strength and a shortened service life.

What explanation/background does the lay reader need to understand the significance of this outcome? (1-2 paragraphs that might include, for example, more on who, when, where; NSF's role; support from multiple directorates/offices; what makes this accomplishment unique; additional intellectual merits; or broader impacts such as education, outreach, or infrastructure improvement that are integral to this outcome; suggested 150 word maximum)

Whether manufacturing metal parts for space stations or airplanes, you need strong, precision parts that last a long time. Selective Laser Melting technology, uses high-powered lasers to melt metal alloy powders layer by layer to 3D print extremely complicated metal parts with less cost and waste.

Louisiana researchers are performing fatigue and tension testing on SLM stainless steel parts and analyzing their structural integrity with neutron imaging. The research team has successfully

demonstrated that neutron imaging can be used to identify the evolution and failing pathway of SLM 3D printed parts before the parts were pushed to the actual point of failure. The major advantages of neutron imaging are the excellent penetration capability and 3D mapping resolution. The knowledge gained is vital for understanding the physics at work inside these metal structures on the molecular level.

Photo:

Neutron tomography image of a stainless steel stress sample. Credit: Les Butler, Louisiana State University, lbutler@lsu.edu.

See this neutron tomography image animated at: https://youtu.be/6dmnvIAWyKU