3D Insights on 3D Printed Superalloys

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Additive manufacturing promises a major transformation of the production of high economic value metallic materials, enabling innovative, geometrically complex designs with minimal material waste. While 3D printed superalloys are likely to replace cast components in many applications, there is not a detailed understanding of the differences in cast vs. additive structure. TriBeam tomography, which integrates electron, ion and femtosecond laser beams to acquire high resolution chemical, structural and crystallographic information has been employed to study Ni- and CoNi-base printed materials. New insights on 3D aspect of printed structure, including cell/dendrite and grain morphology evolution, misorientation accumulation, defect formation and melt pool dynamics will be reviewed. Differences in single crystal vs. additive structure will be highlighted, along with implications for properties. Future directions for the design of "printable" alloys will also be discussed.

Tresa Pollock is the Alcoa Distinguished Professor of Materials at the University of California, Santa Barbara. Pollock's research focuses on the mechanical and environmental performance of materials in extreme environments, unique high temperature materials processing paths, ultrafast laser-material interactions, alloy design and 3-D materials characterization. Pollock graduated with a B.S. from Purdue University in 1984, and a Ph.D. from MIT in 1989. She was employed at General Electric Aircraft Engines from 1989 to 1991, where she conducted research and development on high temperature alloys for aircraft turbine engines and co-developed the single crystal alloy René N6 (now in service). Pollock was a professor in the Department of Materials Science and Engineering at Carnegie Mellon University from 1991 to 1999 and the University of Michigan from 2000 - 2010. Professor Pollock was elected to the U.S. National Academy of Engineering in 2005, the German Academy of Sciences Leopoldina in 2015, and is a DOD Vannevar Bush Fellow and Fellow of TMS and ASM International. She served as Editor in Chief of the Metallurgical and Materials Transactions family of journals from 2017-2025, was the 2005-2006 President of The Minerals, Metals and Materials Society and served as Materials Department Chair (2011 – 2017), Associate Dean of Engineering (2018 – 2021) and Interim Dean of the College of Engineering at UCSB (2021 – 2023).