VIRGINIA TECH

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2150 Torgersen Hall

ULTRASONIC PROCESSING OF BULK NANOSTRUCTURED MATERIALS

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Abstract

Ultrasonic consolidation of powders and foils is a promising approach for manufacturing bulk materials with non-equilibrium structures and exotic properties. In this processing route, a punch presses on the feedstock and oscillates at ultrasonic frequencies perpendicular to the loading axis. These ultrasonic vibrations shear the surface asperities and disrupt the oxide overlayer on the feedstock to achieve metallurgical bonding. The ultrasonic vibrations have been observed to decrease the flow stress of the feedstock, making it easier for the feedstock to bond under a low normal stress; however, the physical mechanism that drives this softening is still a matter of debate. Some researchers attribute softening to frictional heating while others argue for an acoustic softening effect where elastic waves increase the mobility of glissile dislocations. Here we resolve this controversy by combining heat transfer theory and plasticity models to show that flash heating drives junction growth in ultrasonic consolidation processes. The talk will show how these insights can be used to determine parameter sets for fabricating high-strength bulk nanostructured materials via ultrasonic consolidation of nanocrystalline foil and powder feedstock

Bio-sketch

Dr. Cordero is currently an assistant professor of Materials Science and NanoEngineering at Rice University. He earned his B.S. in Physics and his Ph.D. in Materials Science and Engineering from MIT. After receiving his PhD, Dr. Cordero spent one year as a post-doctoral fellow at the Manufacturing Demonstration Facility of the Oak Ridge National Laboratory where he developed improved process monitoring, quality control, and microstructure design tools for powder-bed metal additive manufacturing technologies. Dr. Cordero launched the Additive Lab at Rice University in 2016