

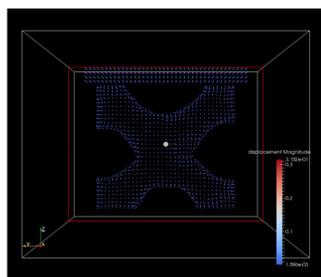
S&T Campaign: Materials Research
Manufacturing Science
Advanced & Additive Manufacturing

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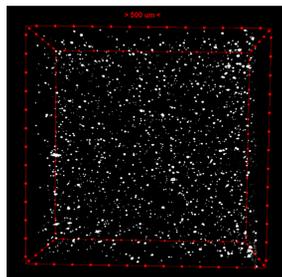
Research Objective

- Utilize advanced 3D imaging and data analysis capabilities to discover and understand processing-microstructure-property relationships
- Utilize computational simulations and in-situ mechanical testing to explore material behavioral mechanisms

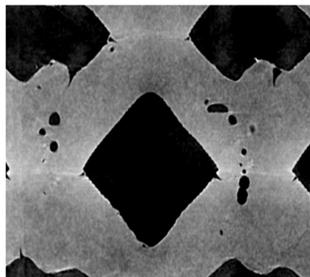
Computational simulations



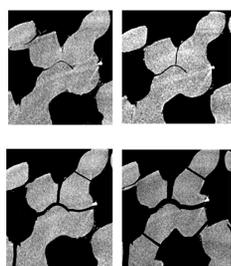
Particle size distribution



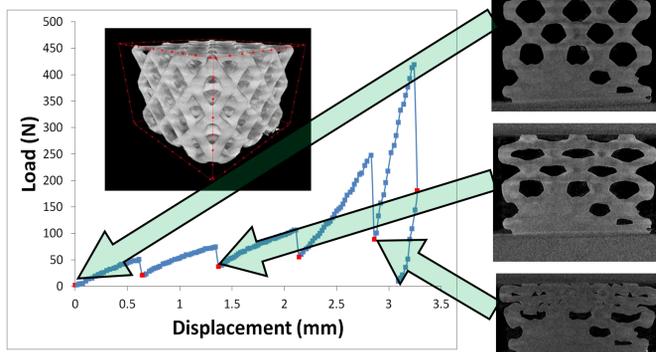
Defect/Porosity Analysis



Crack propagation and failure



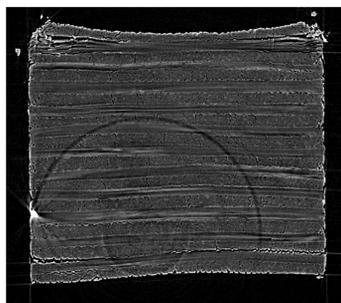
In-situ mechanical testing



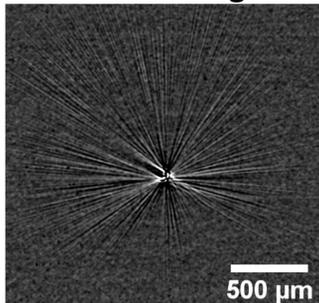
Challenges

- Resolution limitations, x-ray penetrating power, contrast between similar attenuating phases, and scanning artifacts are known challenges for computed tomography
- Most scanning artifacts, however, can be eliminated or significantly reduced with optimized scanning parameters or artifact corrections during the reconstruction process

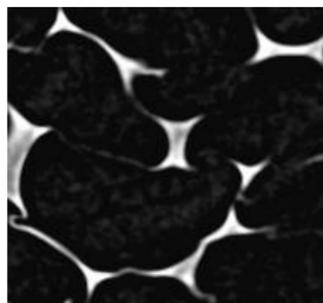
Ring artifacts



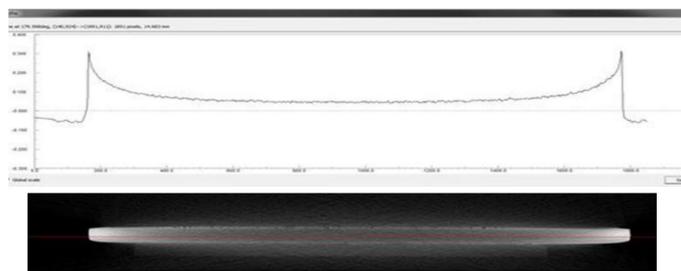
Streaking



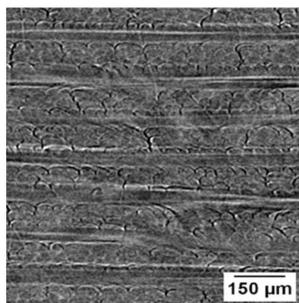
Background noise



Beam hardening

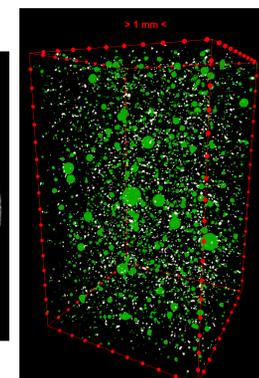
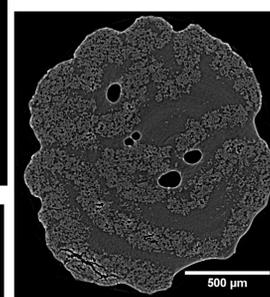
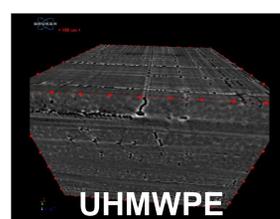
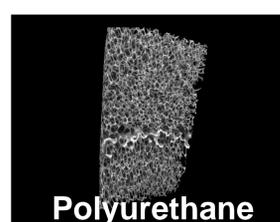


Pixel shifts



ARL Facilities and Capabilities Available to Support Collaborative Research

- Bruker Skyscan 1172**
 - 0.5 um voxel size
 - 20-100 kV
- Zeiss Xradia 520**
 - 70 nm voxel size
 - 30-160 kV
 - Phase contrast enhanced imaging
- 225/450 kV System**
- In-situ mechanical testing**
- Data analysis software**
- Computational modeling and finite element analysis**
- ARL CT expertise includes a wide range of materials:**
 - Composites (UHMWPE, Carbon fiber, Glass fiber)
 - Ceramics (B4C, Al2O3, SiC)
 - Metals (Aluminum and metallic coatings)
 - Polymers (PC, ABS, polyurethane foams)
 - Bio-materials (trabecular bone)
 - Multi-material and hybridized structures (concrete, metal-ceramic interfaces)



Complementary Expertise / Facilities / Capabilities Sought in Collaboration

- Advanced data analytics
- Digital volume correlation for in-situ mechanical testing
- Complementary microscopy facilities not available at ARL
- Unique material processing or mechanical testing capabilities that would be used collaboratively to establish processing-microstructure or microstructure-property relationships