

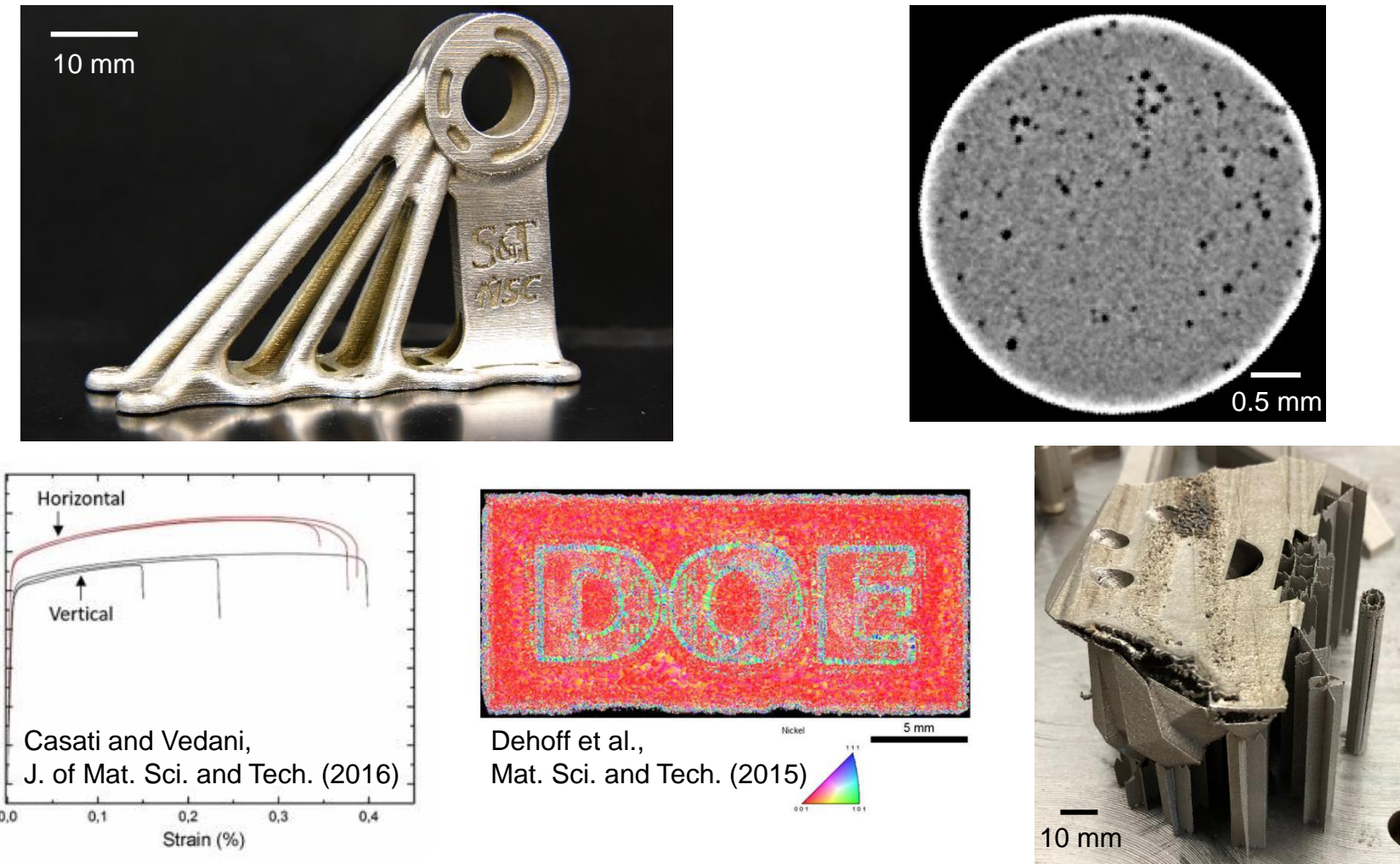
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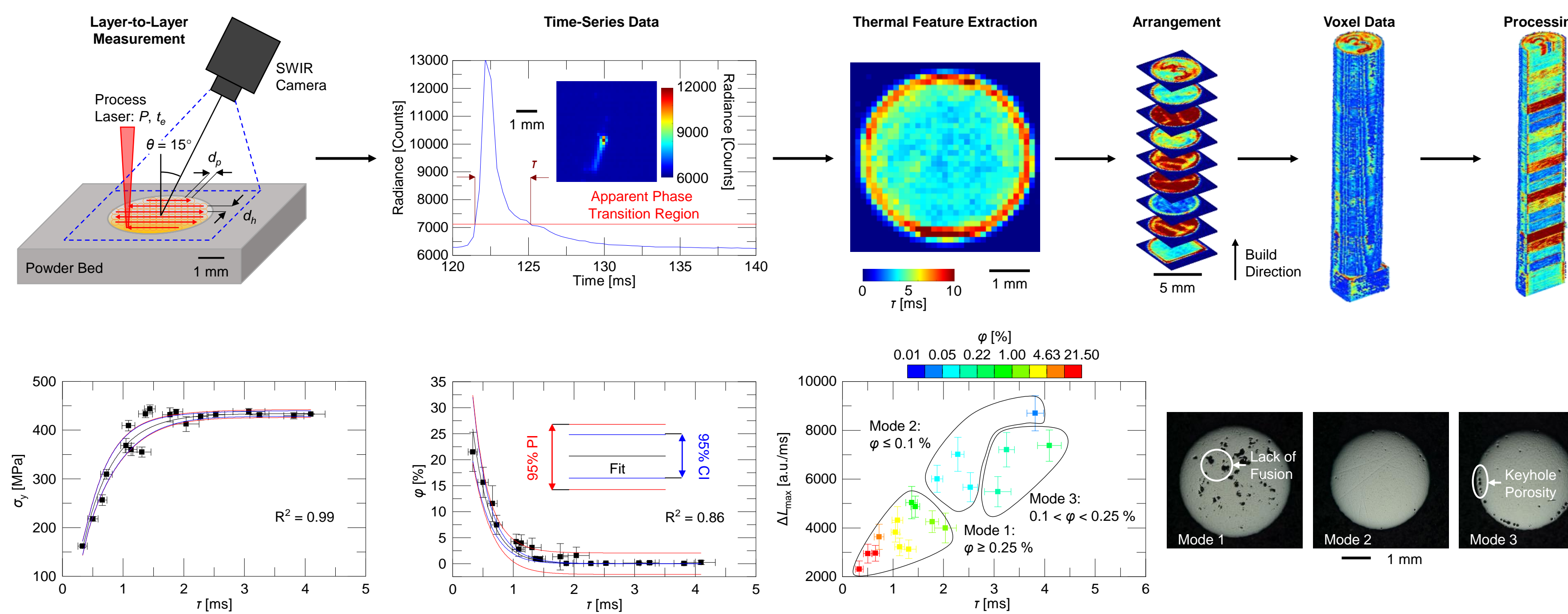
Motivation

- Laser Powder Bed Fusion (LPBF) gives ability to manufacture high resolution complex geometries
- Challenges still exist
 - Inadequate part properties
 - Inhomogeneous microstructure
 - Thermal and residual stress
 - Part qualification
- In-process qualification of 304L SS microstructure locally overall research goal



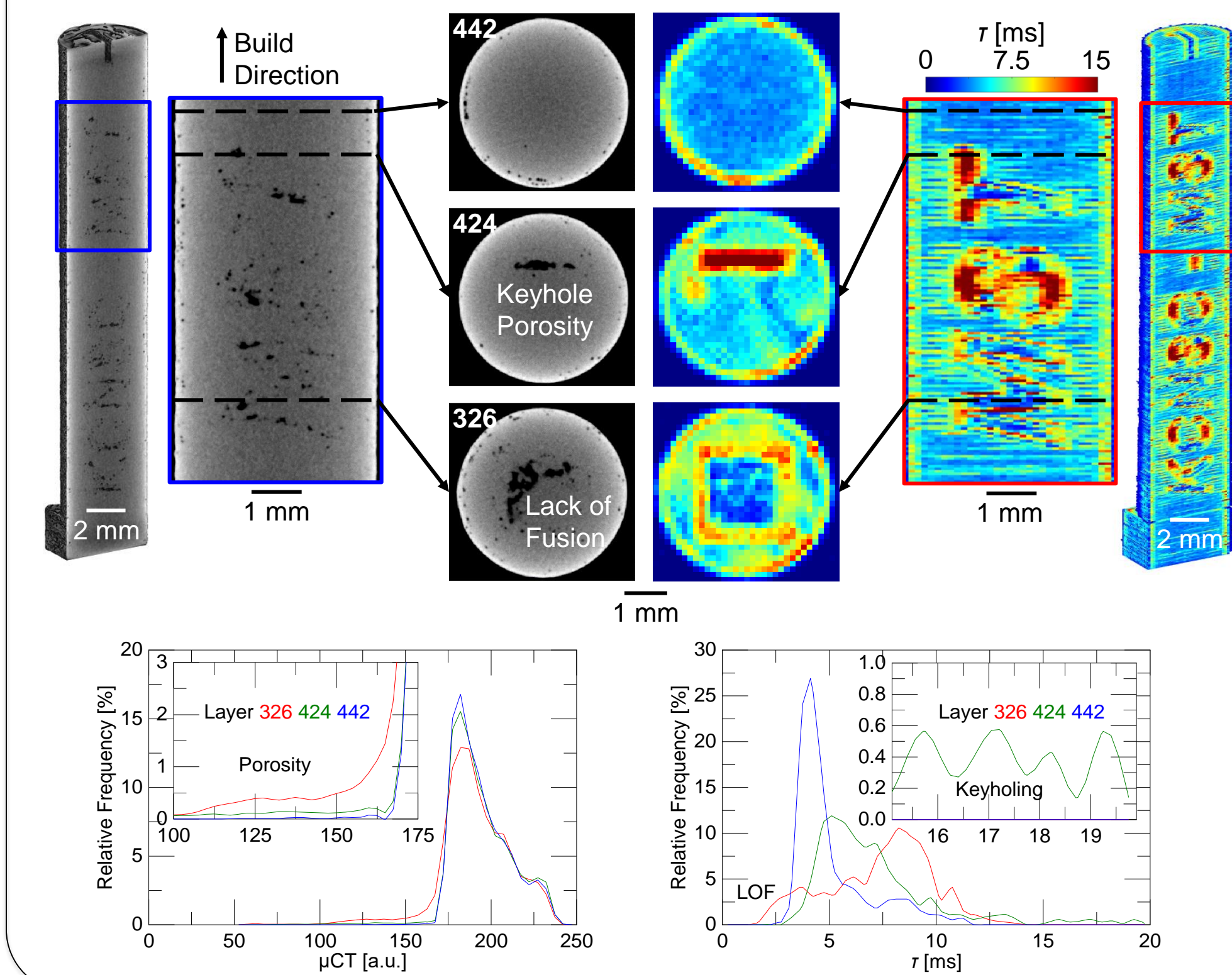
Shortwave Infrared Imaging

- SWIR thermal camera with high dynamic range over 0.9-1.7 μm
- Laser processing recorded from layer-to-layer
- Thermal features extracted to produce voxel based reconstructions of parts
- Correlations developed between thermal features and part properties
- Opportunity provided to locally qualify part properties



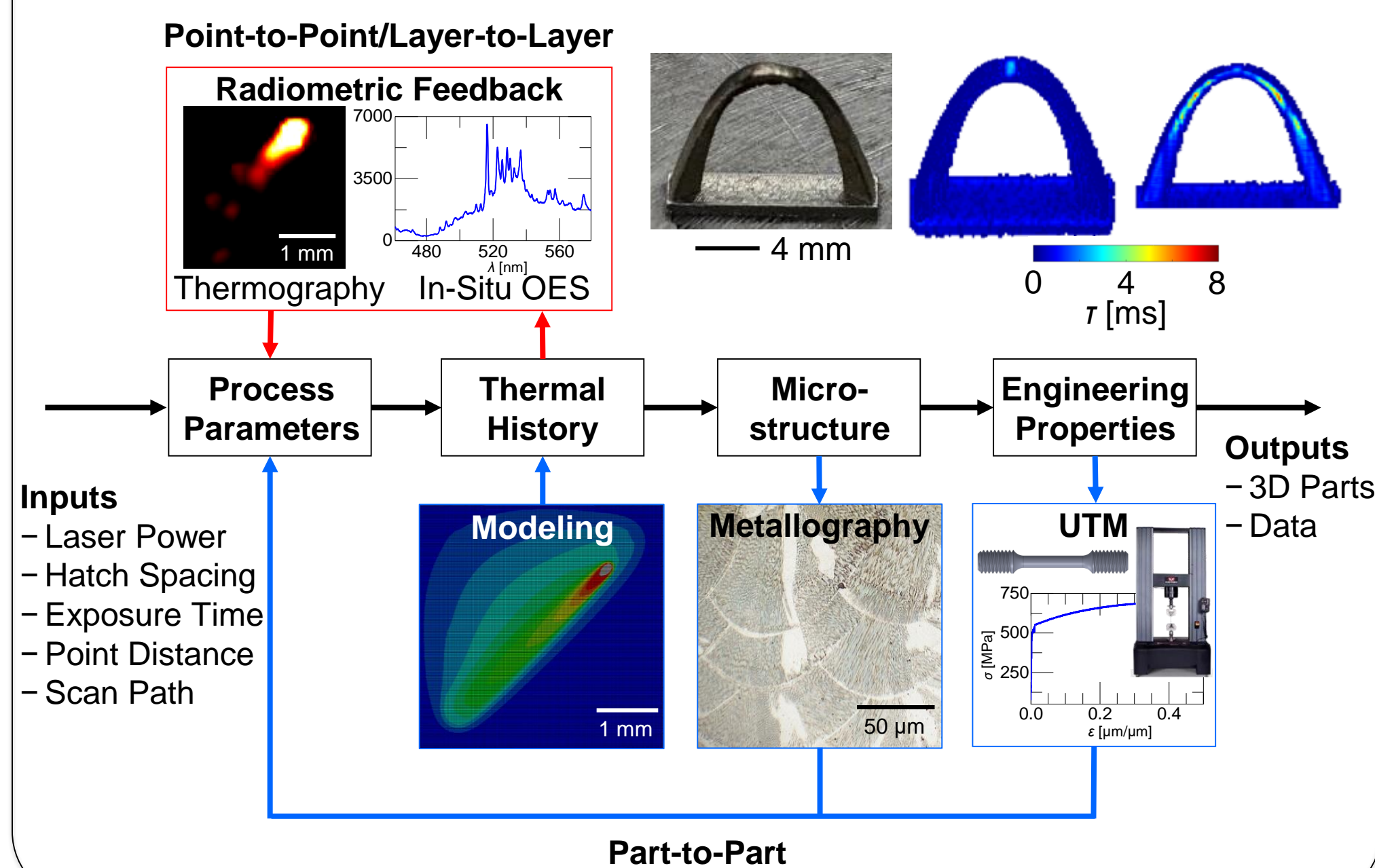
Voxel Based Data

- Micro-CT scanning for framework validation
- SWIR voxel based reconstructions capture local features within part volumes



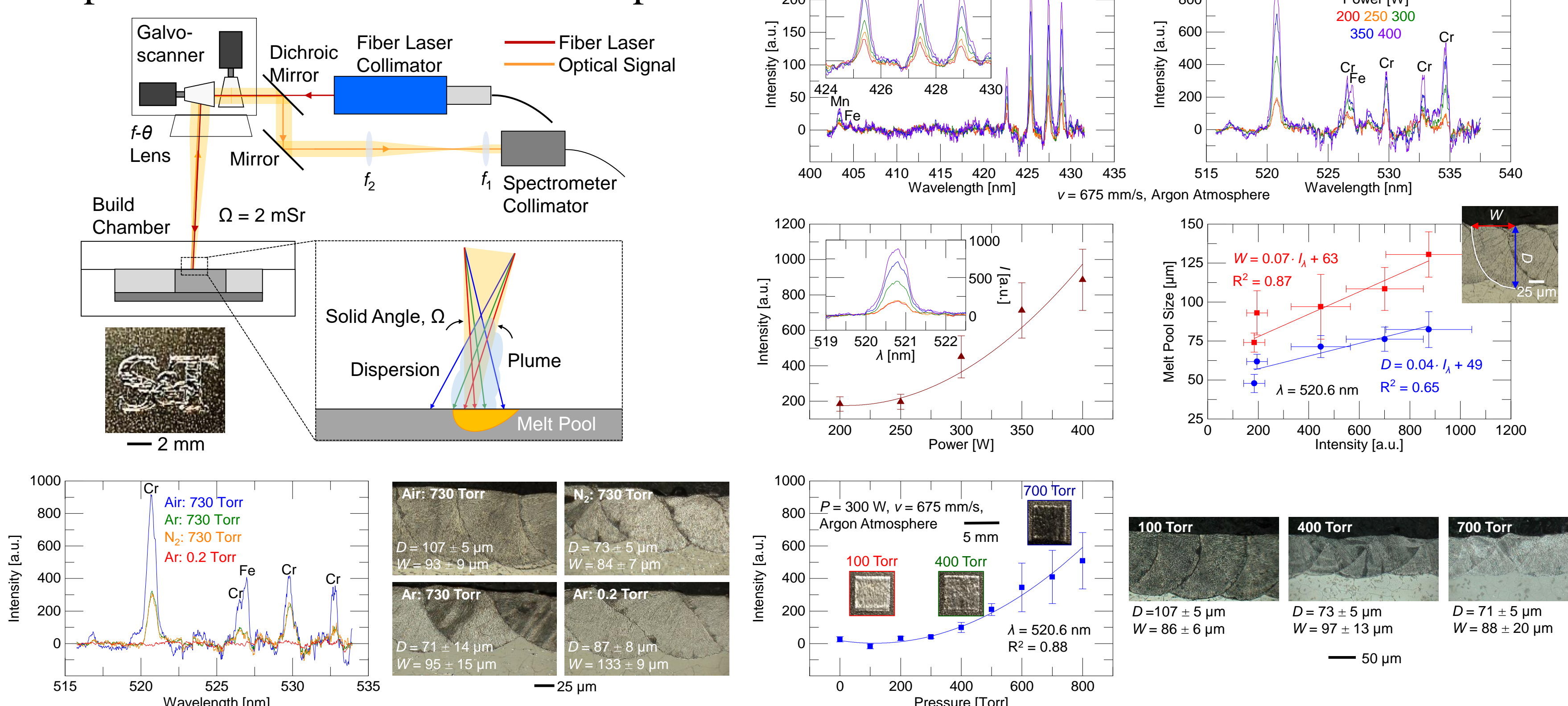
Methods

- Renishaw AM250 LPBF system
 - 200 W laser with step/scan exposure strategy
- In-situ monitoring of radiometric signals
 - Shortwave Infrared (SWIR) imaging
 - Optical Emission Spectroscopy (OES)
 - Correlate measurements with part properties
- Generate voxel based data for parts



Optical Emission Spectroscopy

- Andor Technology SR-750 spectrometer, visible wavelengths 0.4-0.7 μm
- Optical emission monitoring of signals from vaporized alloying elements
- OES signal intensities vary with LPBF processing conditions including process laser power and build chamber atmosphere



Summary

- In-situ part qualification needed in LPBF
- Radiometric process monitoring provides information that correlates with part properties
 - SWIR imaging and OES
- Voxel based processing generates data sets indicative of part state on local basis
- SWIR imaging reconstructions capture features that occur due to various phenomena in the part volume

Acknowledgement

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