
***Introduction and Rapid Solidification in Ni and Al
Alloys***

***Semi-annual Spring Meeting
April 2022***

- Postdoc: Adriana Eres-Castellanos (Mines)
- Faculty: Kester Clarke and Amy Clarke (Mines)

About me

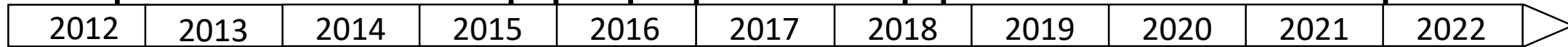
EDUCATION

B. E. Industrial Technologies Engineering at University of Oviedo (ES)

Exchange semester at Selçuk University (TR)

M. E. Materials Engineering at Technical University of Madrid (ES)

PhD. Science and Technology (crystallography) at Menendez Pelayo International University (ES)



WORK

Research intern at ArcelorMittal R&D Ghent (BE)

Visiting research intern at University of Kaiserslautern (DE)

PhD Candidate at National Center for Metallurgical Research (ES)

Visiting PhD Candidate at École de technologie supérieure (CA)

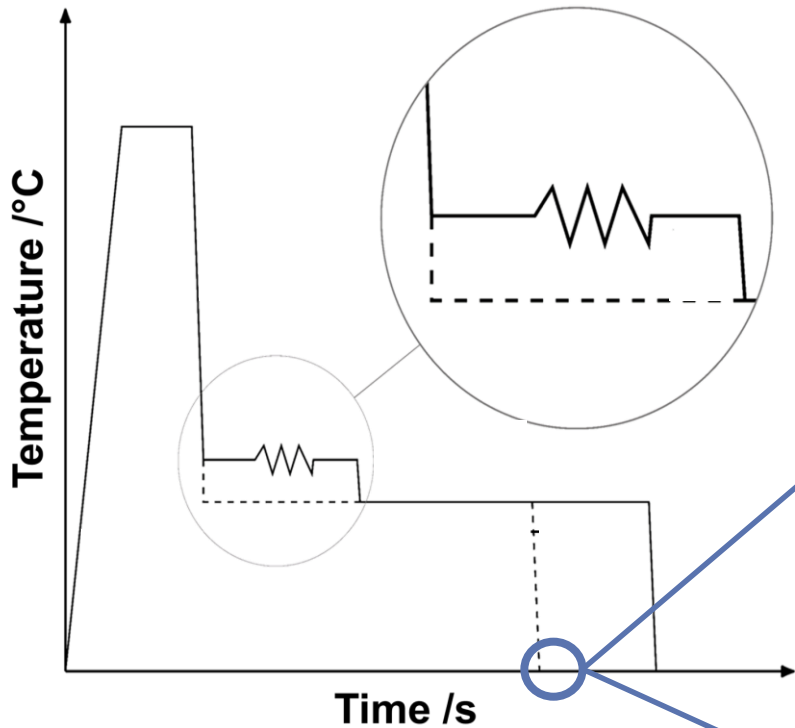
Postdoc at Colorado School of Mines (US)

Research intern at National Center for Metallurgical Research (ES)



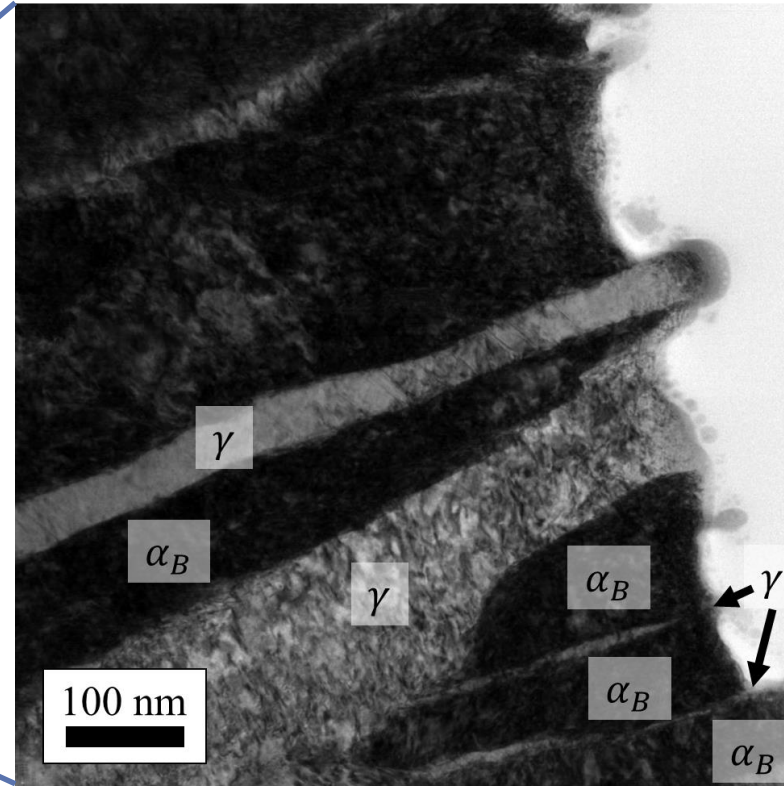
Background: phase transformations in steels

Ausforming treatments in medium carbon high silicon steels



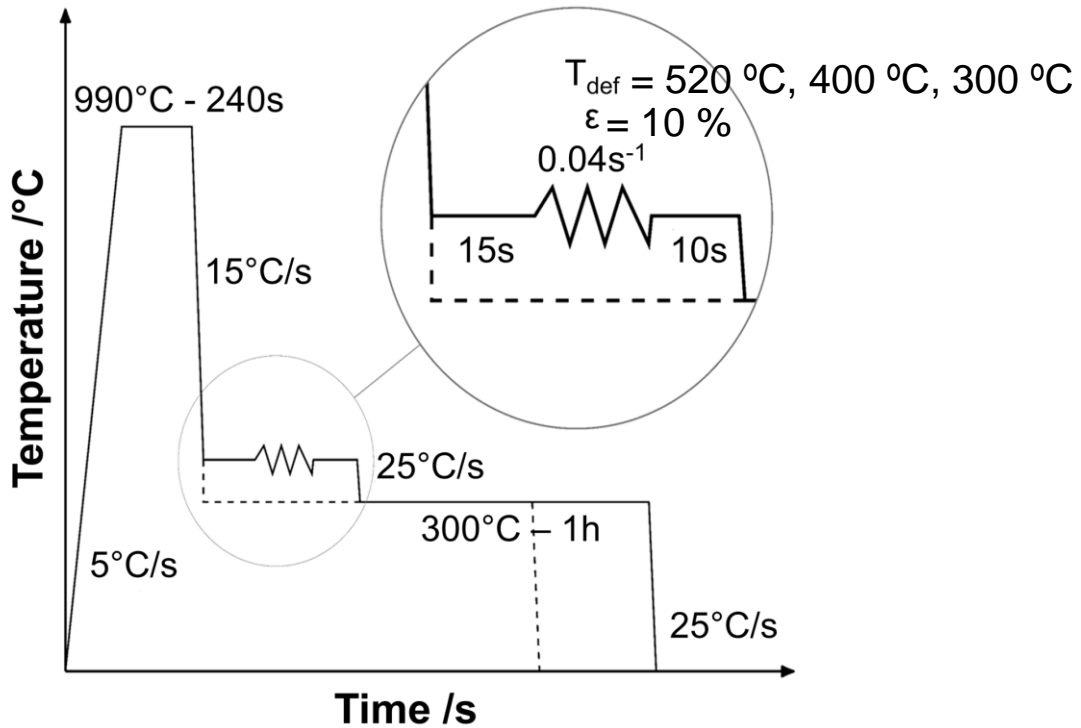
Benefits: faster treatments and, potentially, more refined bainitic microstructures

Drawbacks: stress/strain induced transformations and variant selection/transformation anisotropy



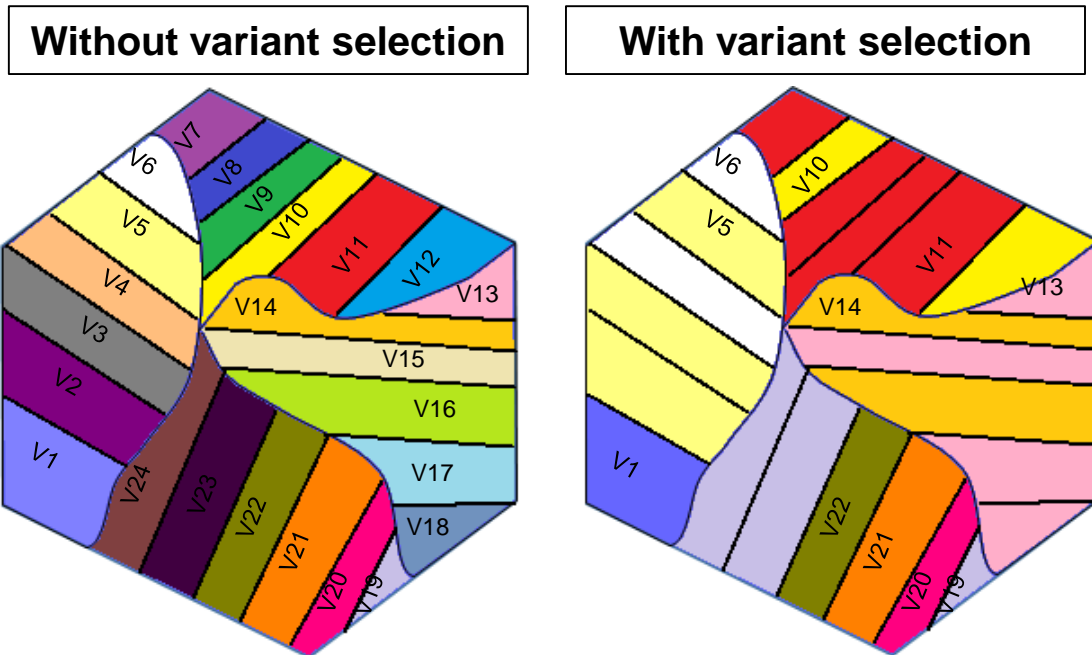
Background: phase transformations in steels

Ausforming treatments in medium carbon high silicon steels

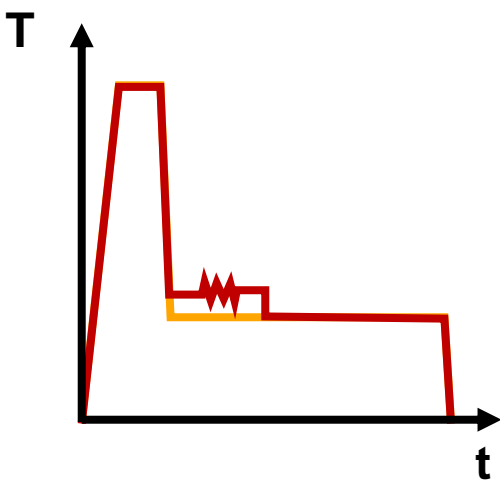
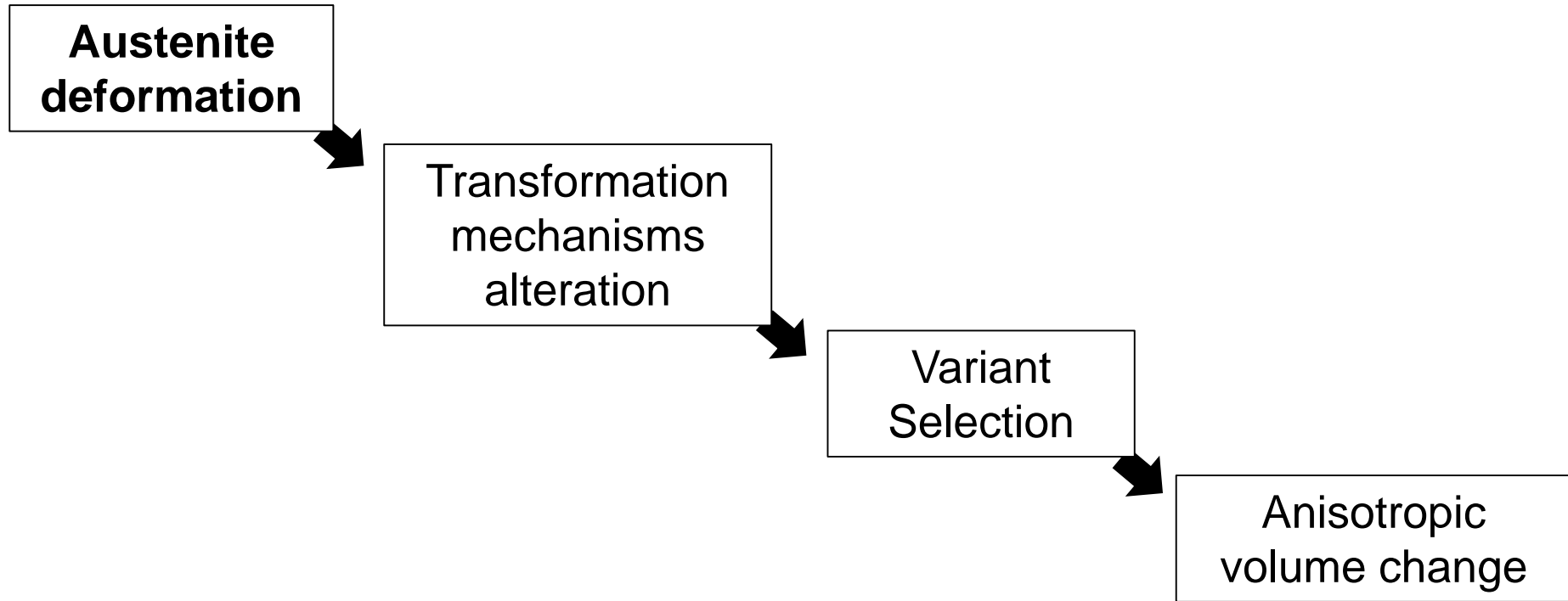


Benefits: faster treatments and, potentially, more refined bainitic microstructures

Drawbacks: **stress/strain induced transformations** and **variant selection/transformation anisotropy**



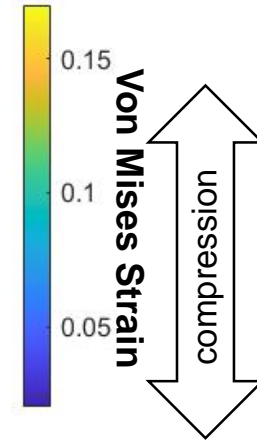
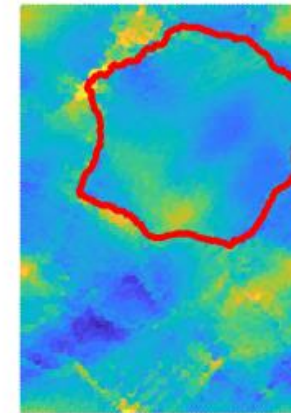
Variant selection and transformation anisotropy



Variant selection and transformation anisotropy

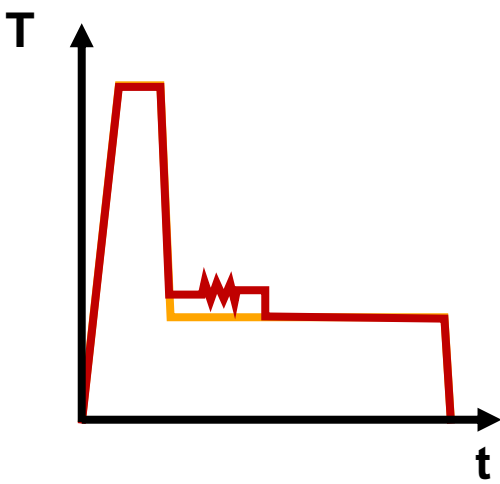
Austenite
deformation

Transformation
mechanisms
alteration



Variant
Selection

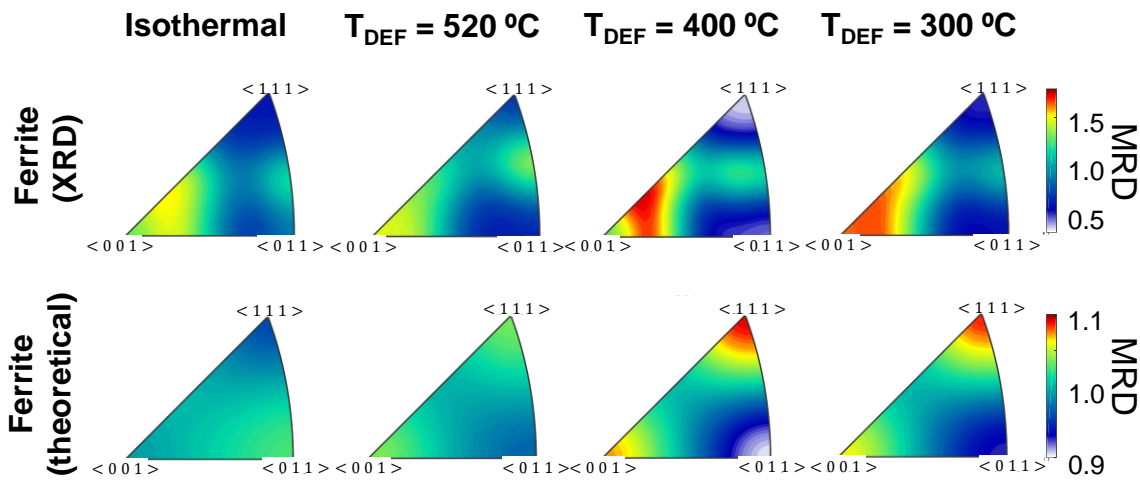
Anisotropic
volume change



Variant selection and transformation anisotropy

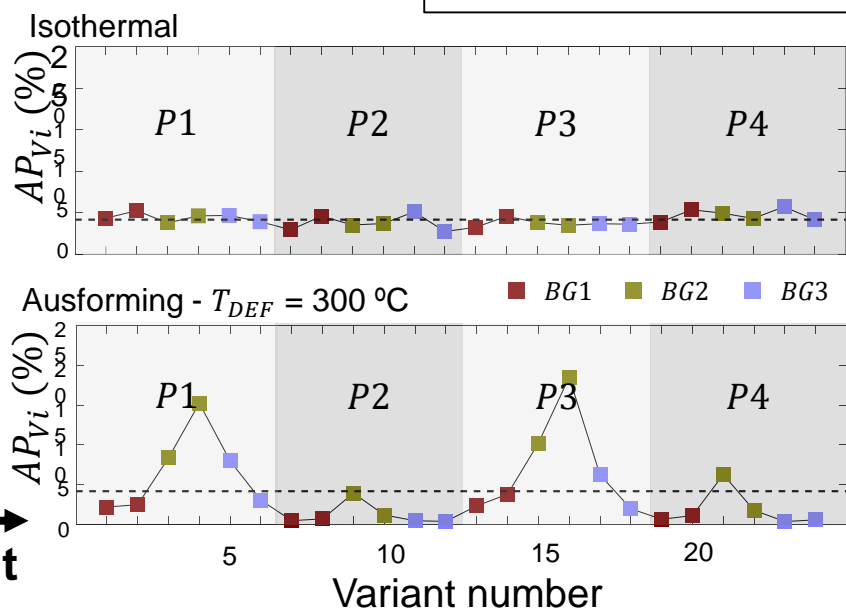
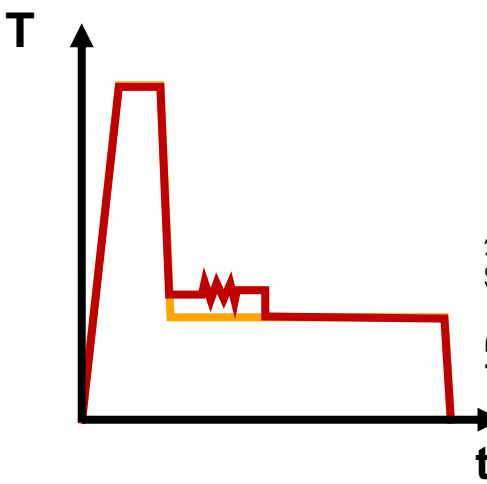
Austenite deformation

Transformation mechanisms alteration

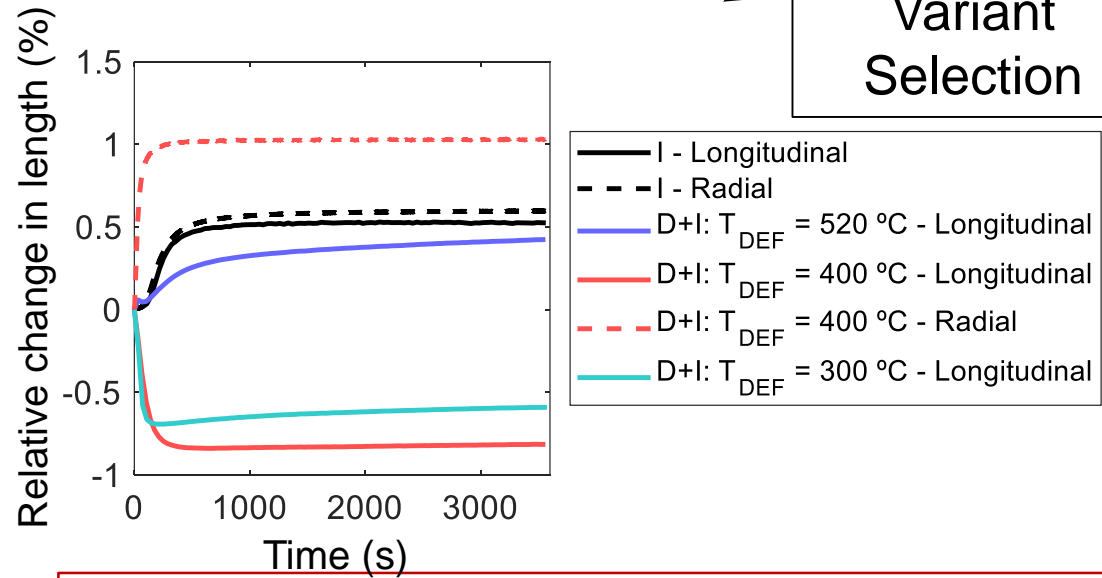
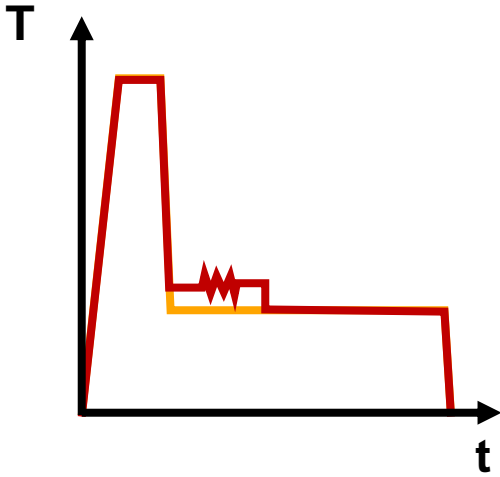
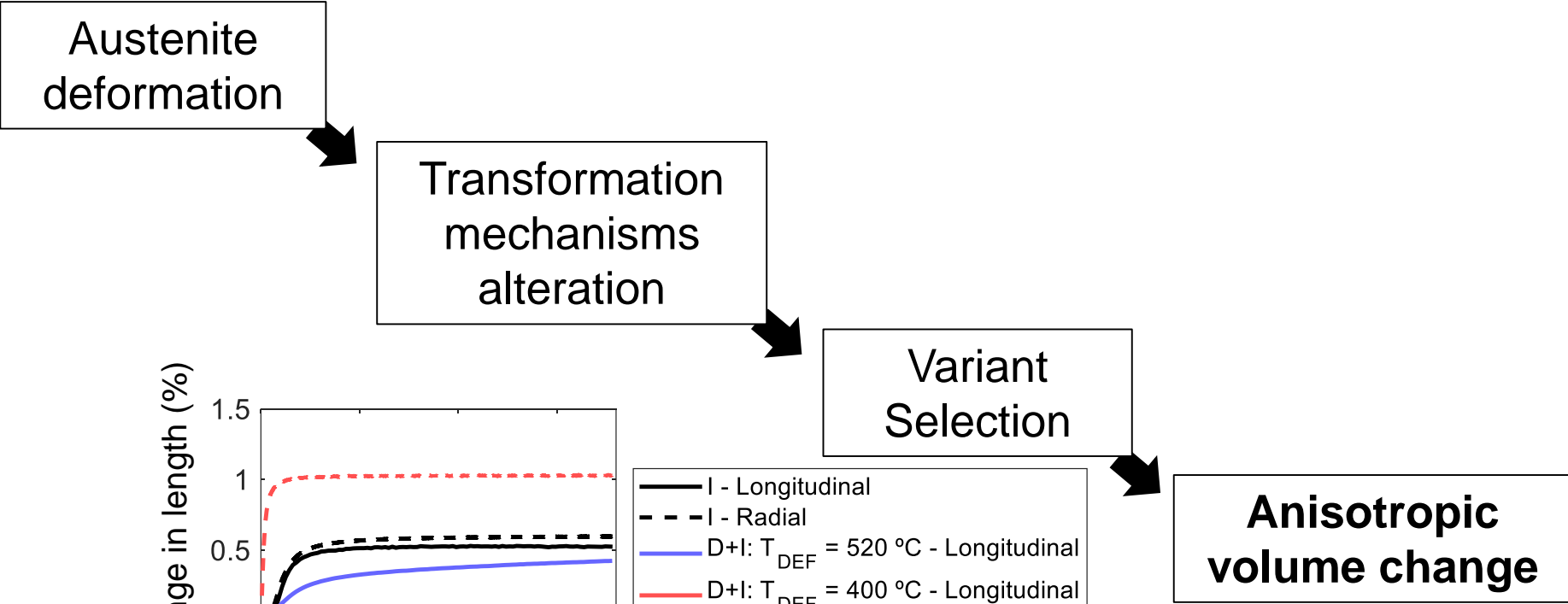


Variant Selection

Anisotropic volume change



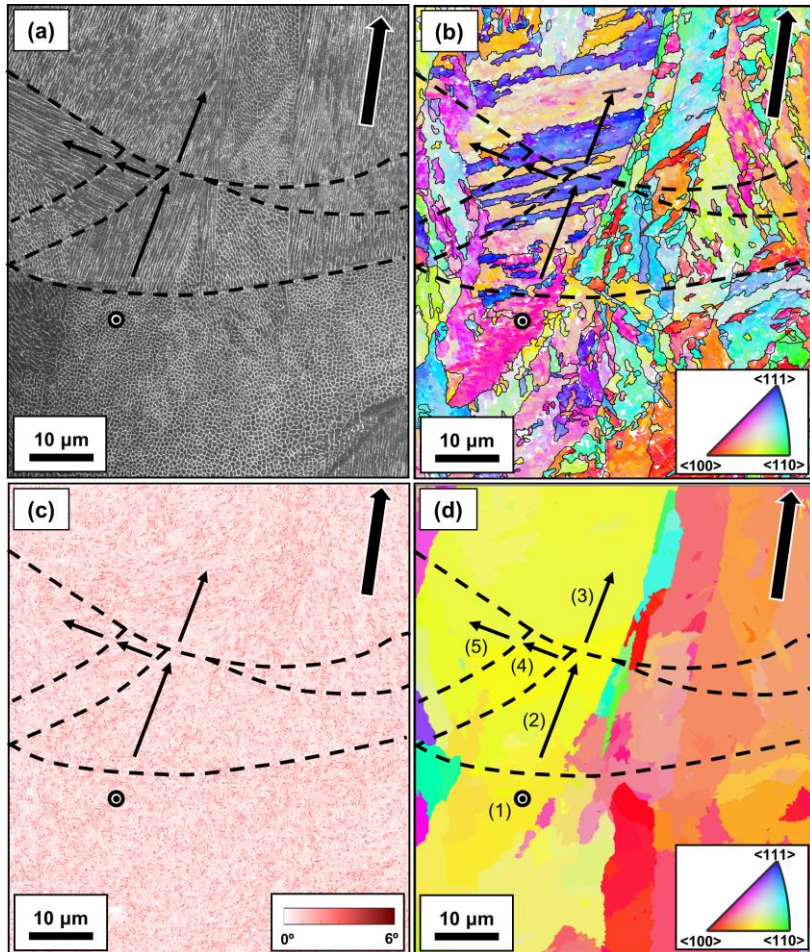
Variant selection and transformation anisotropy



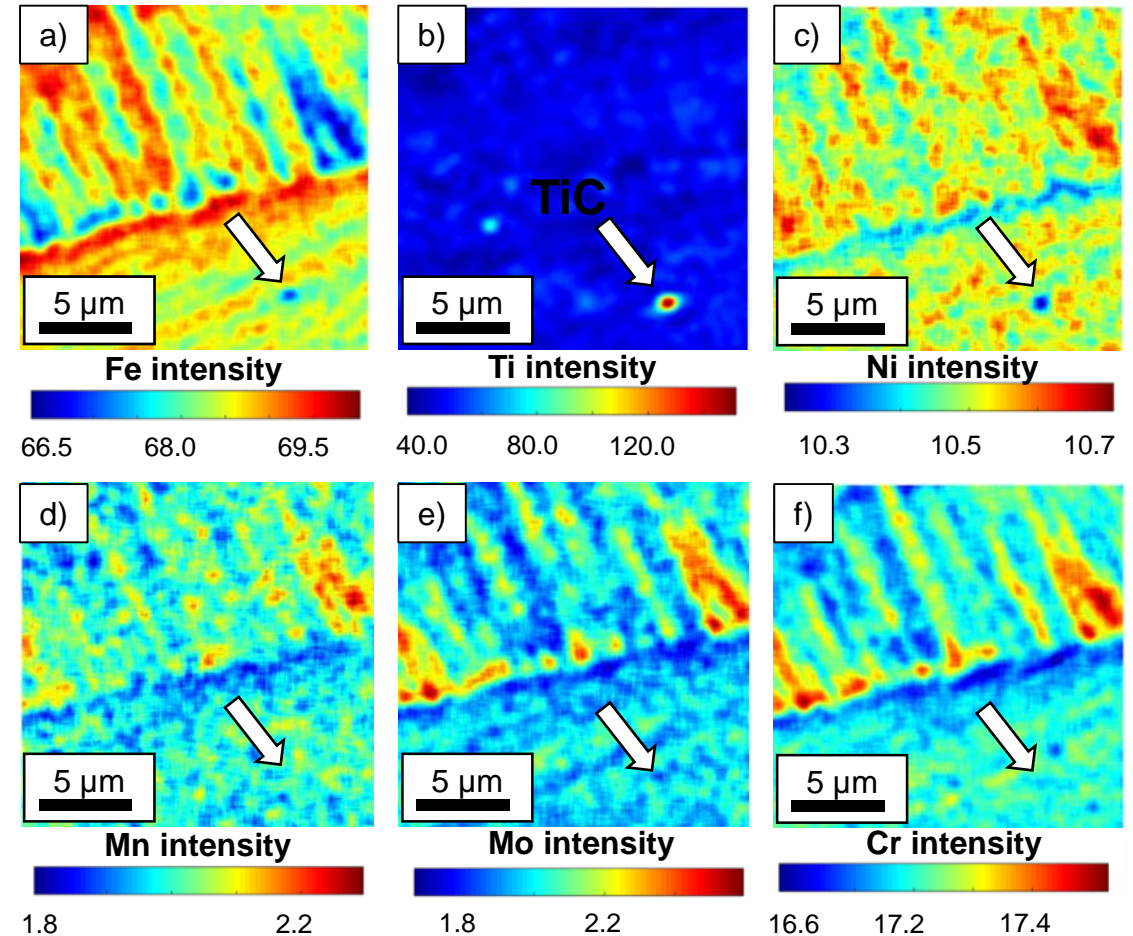
Looking for a different research topic...

Additive manufacturing in steels

Maraging 300

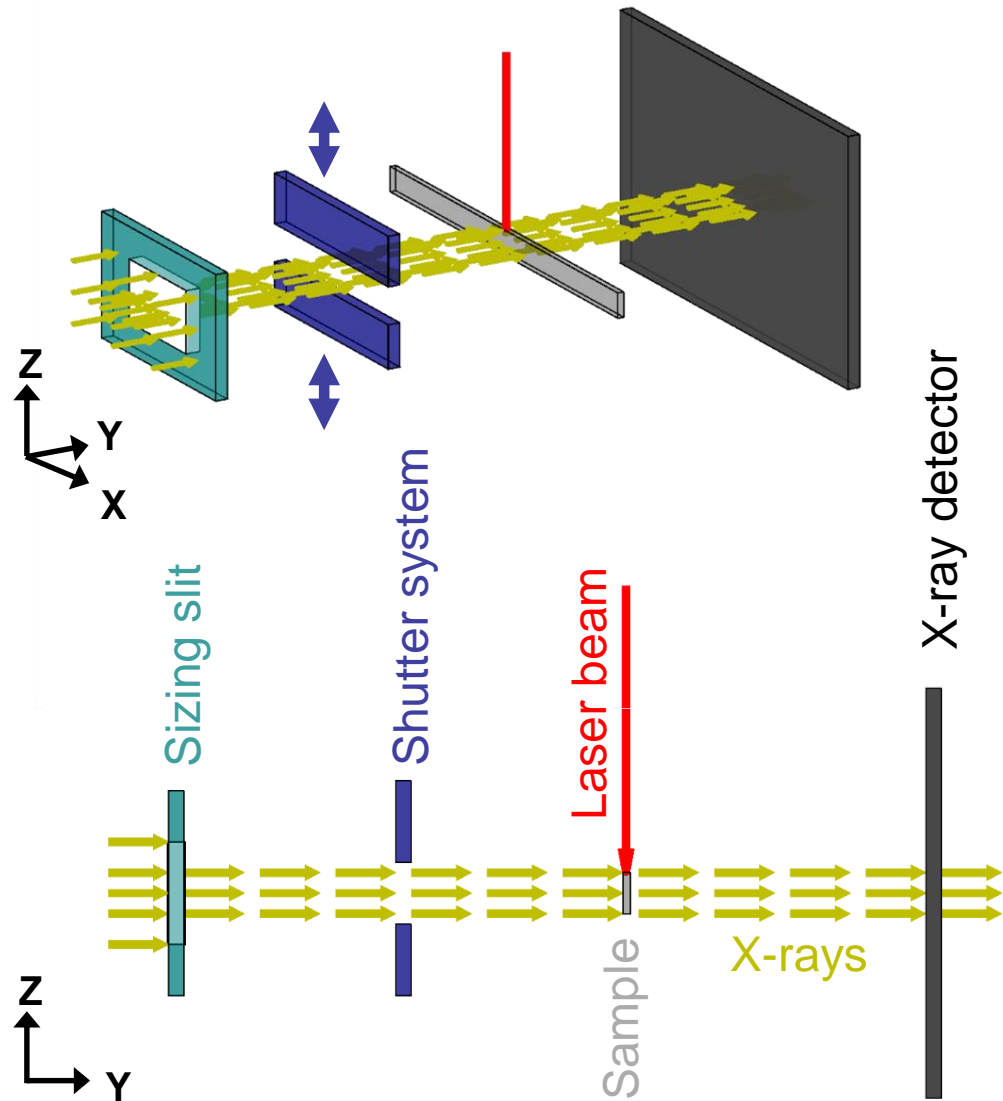


316L (+TiC particles)



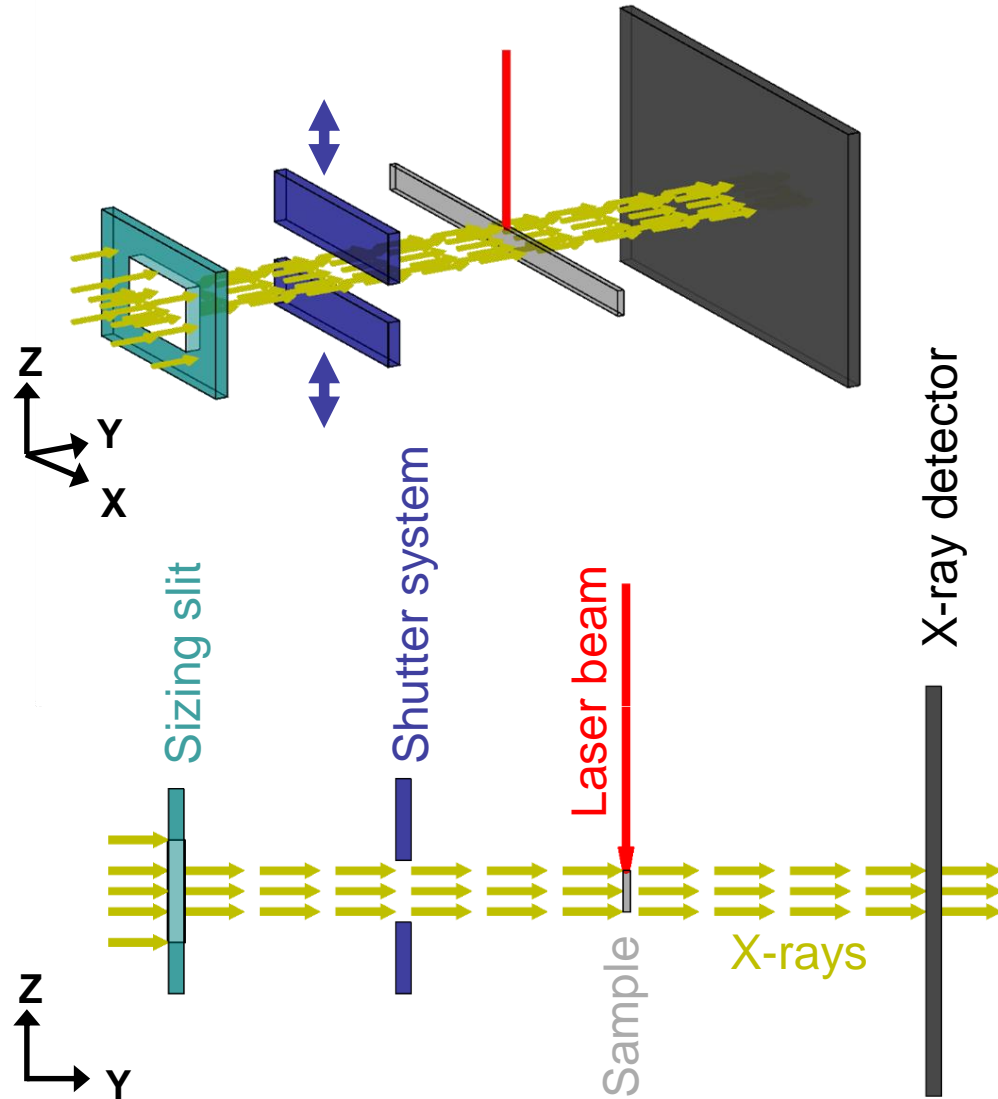
Additive manufacturing in non-ferrous alloys

In situ study of IN738 processed under different laser powers



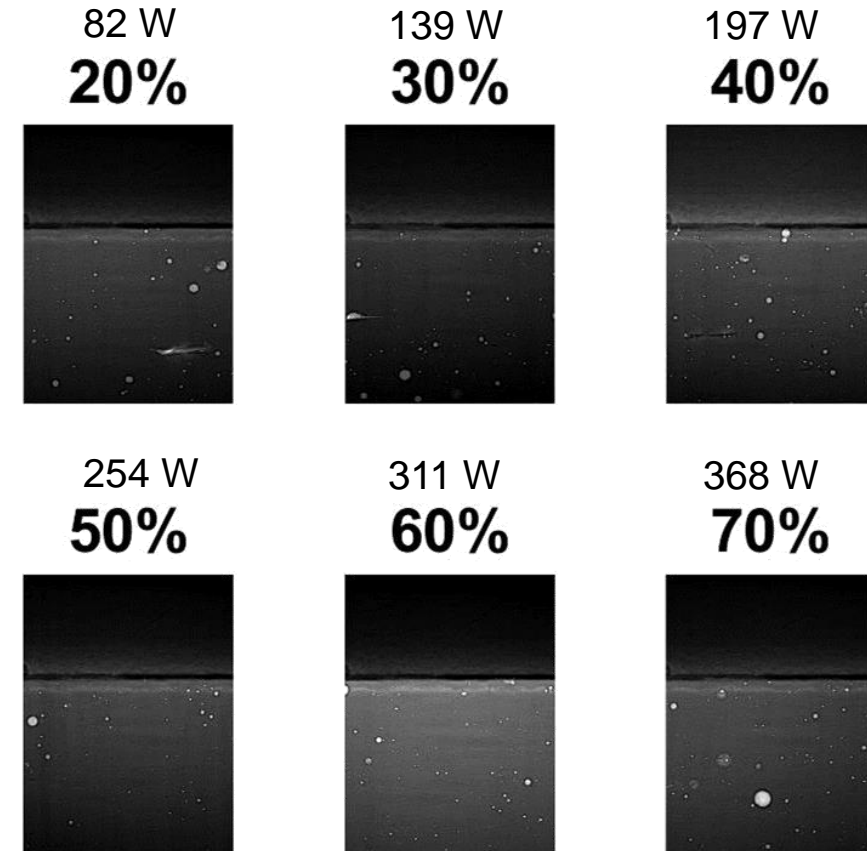
Additive manufacturing in non-ferrous alloys

In situ study of IN738 processed under different laser powers



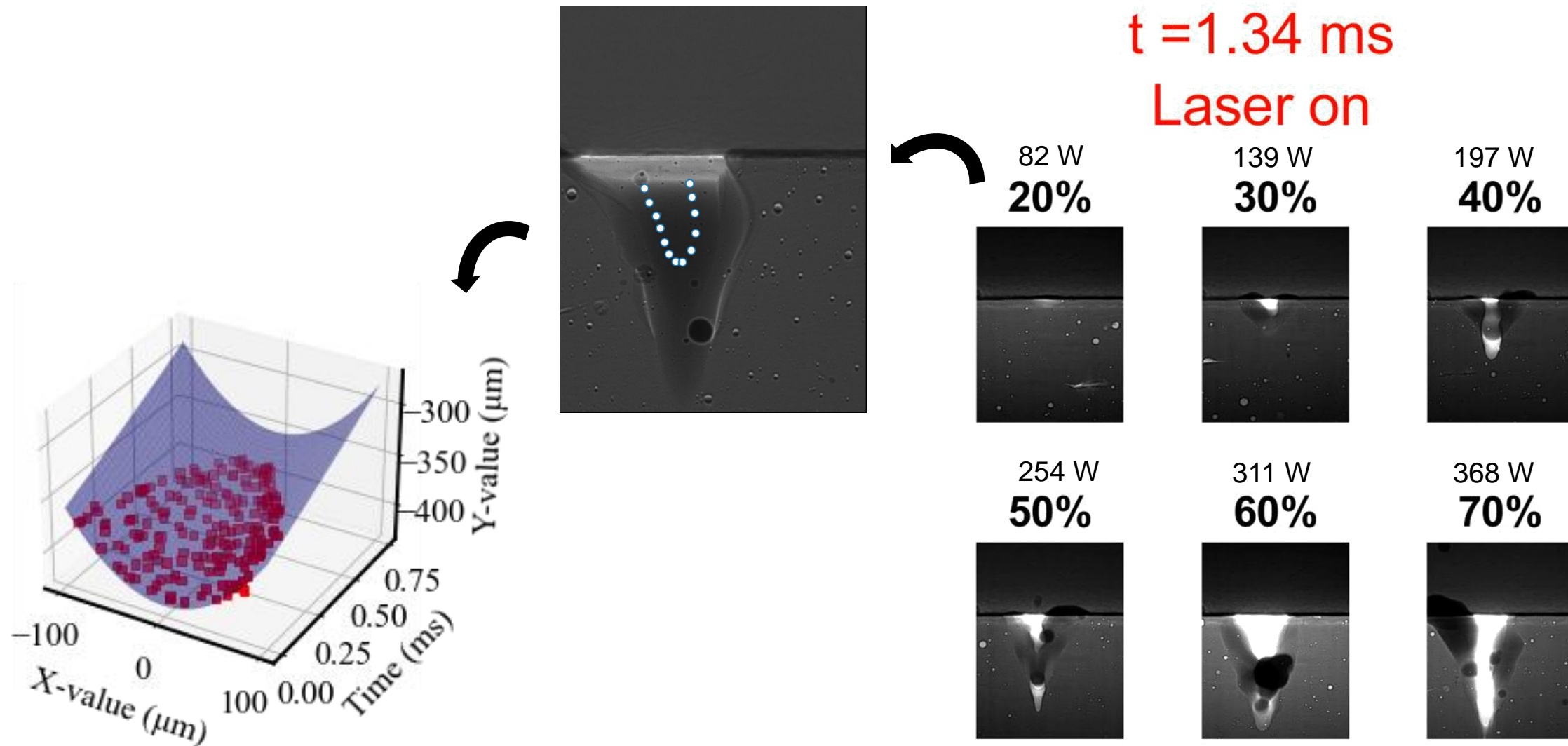
$t = 0.34$ ms

Laser off



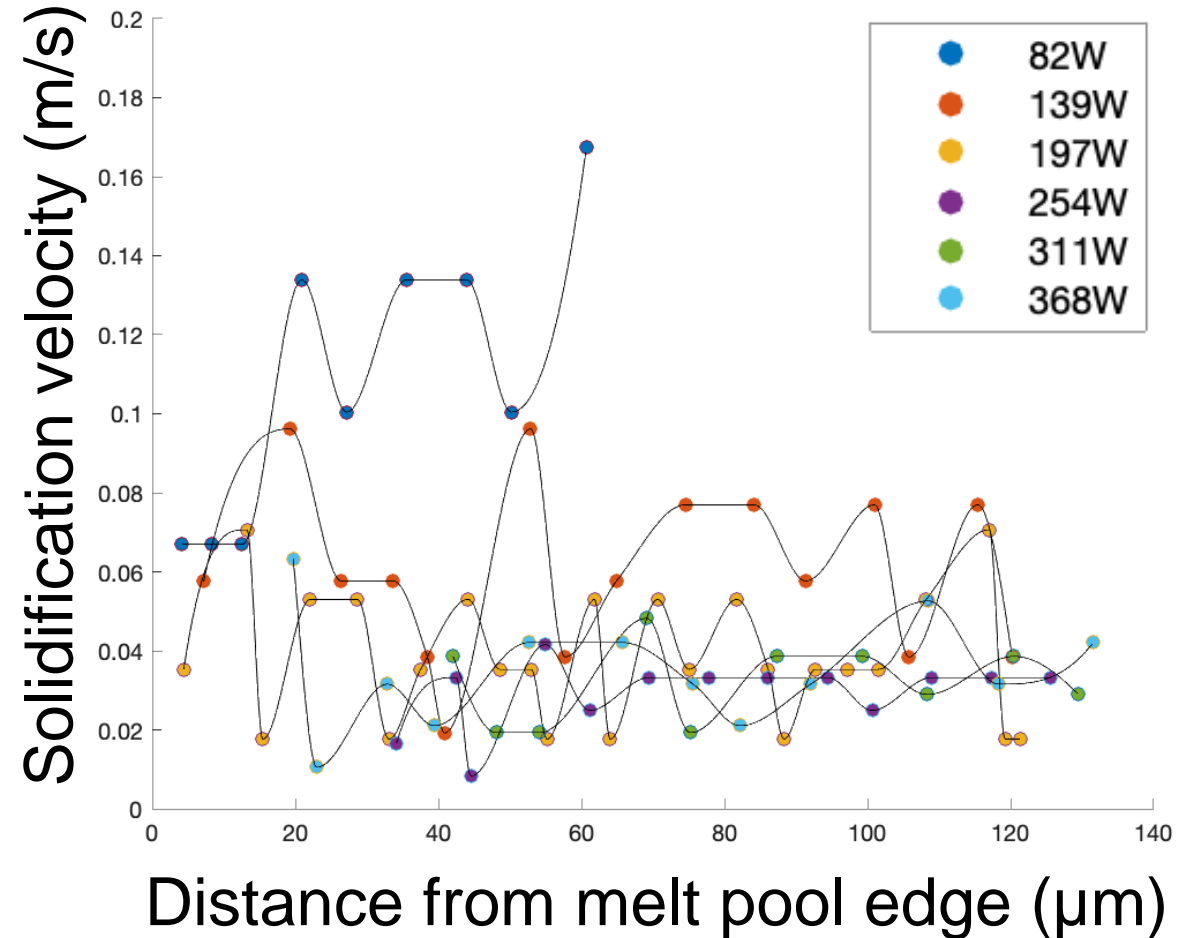
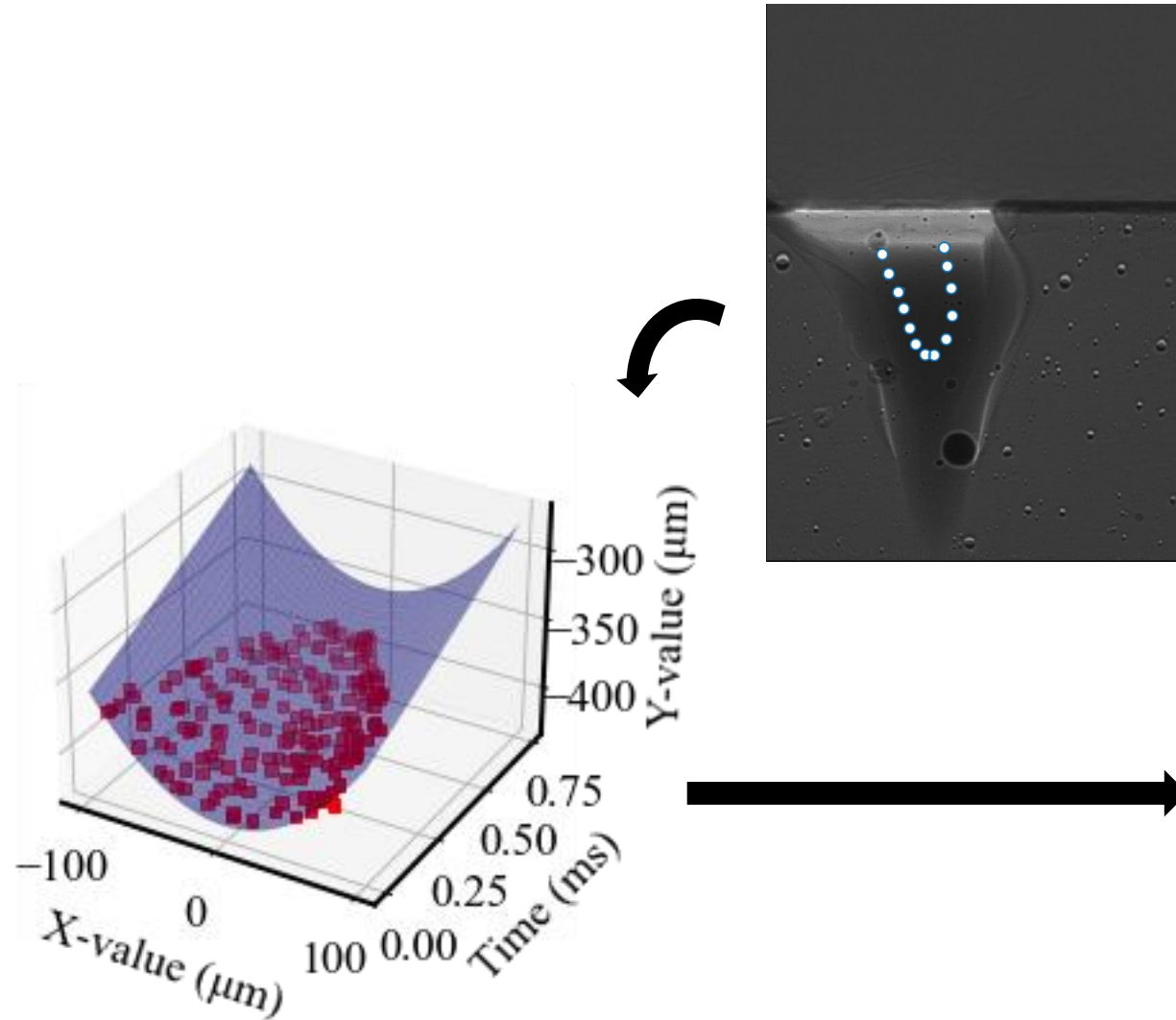
Additive manufacturing in non-ferrous alloys

In situ study of IN738 processed under different laser powers



Additive manufacturing in non-ferrous alloys

In situ study of IN738 processed under different laser powers



Additive manufacturing in non-ferrous alloys

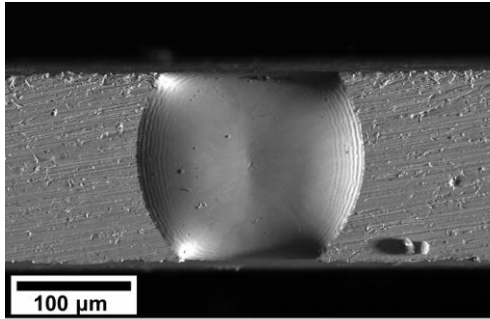
In situ study of IN738 processed under different laser powers



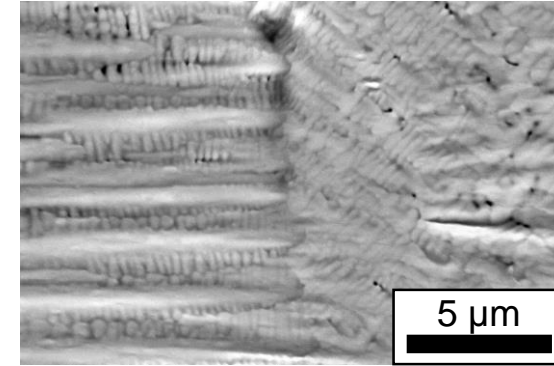
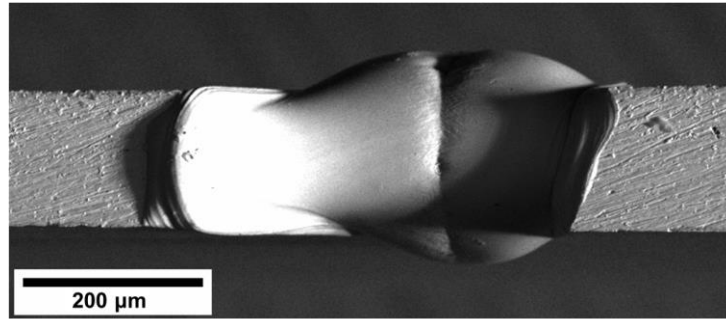
CANFSA

CENTER FOR ADVANCED
NON-FERROUS STRUCTURAL ALLOYS

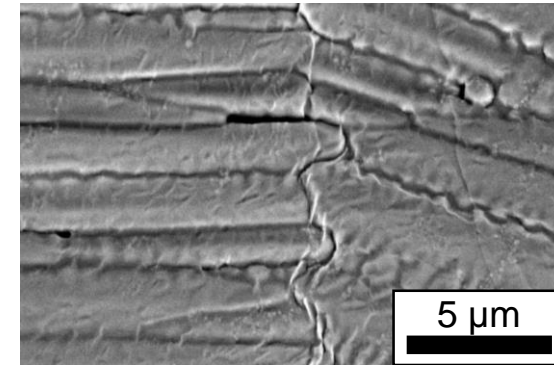
82 W



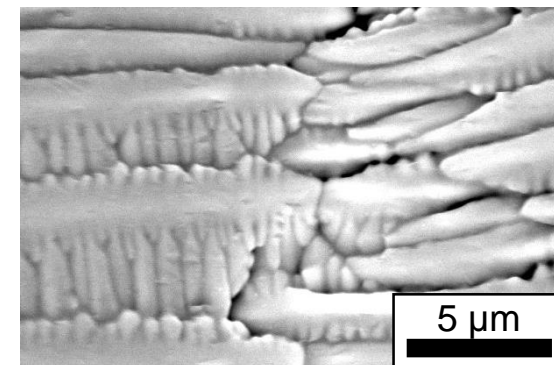
368 W



139 W



154 W



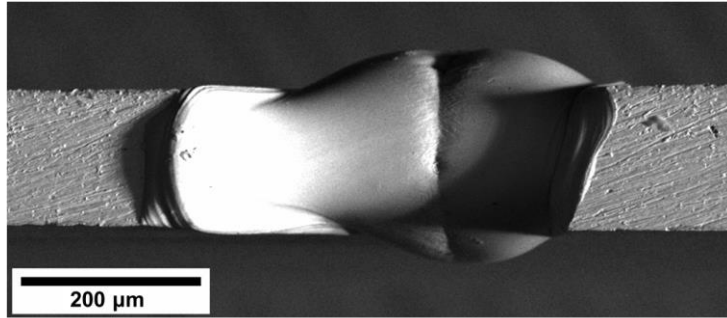
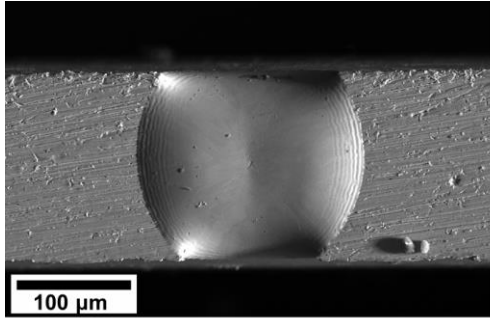
311 W

Additive manufacturing in non-ferrous alloys

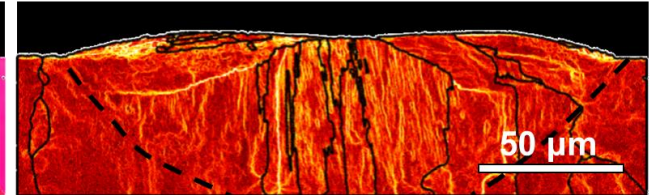
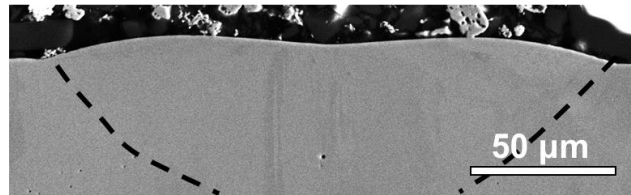
In situ study of IN738 processed under different laser powers

82 W

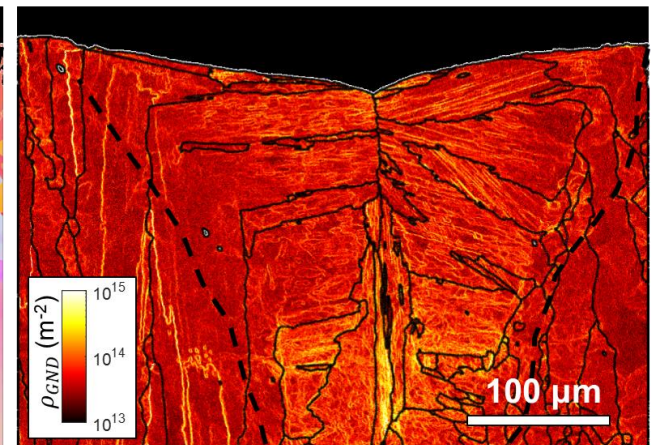
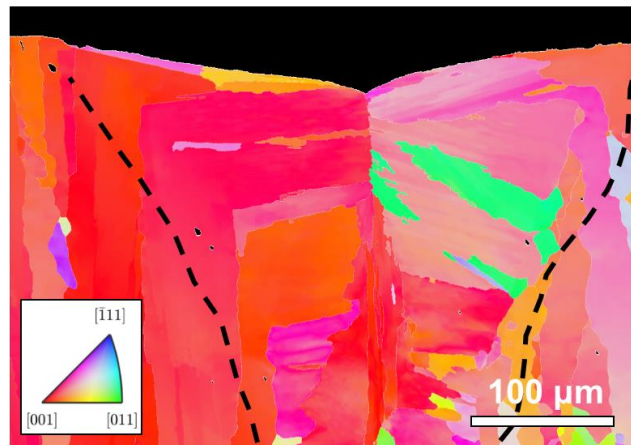
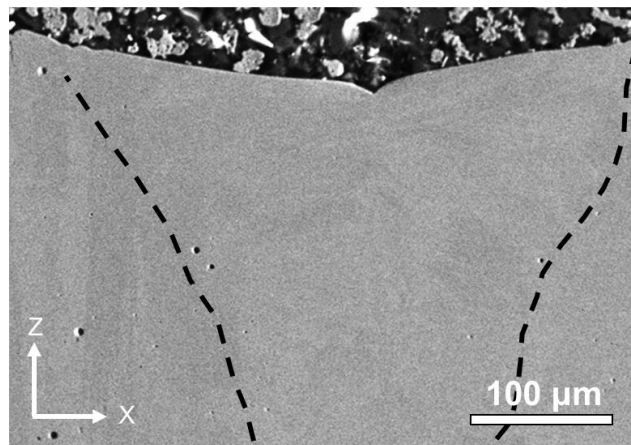
368 W



82 W

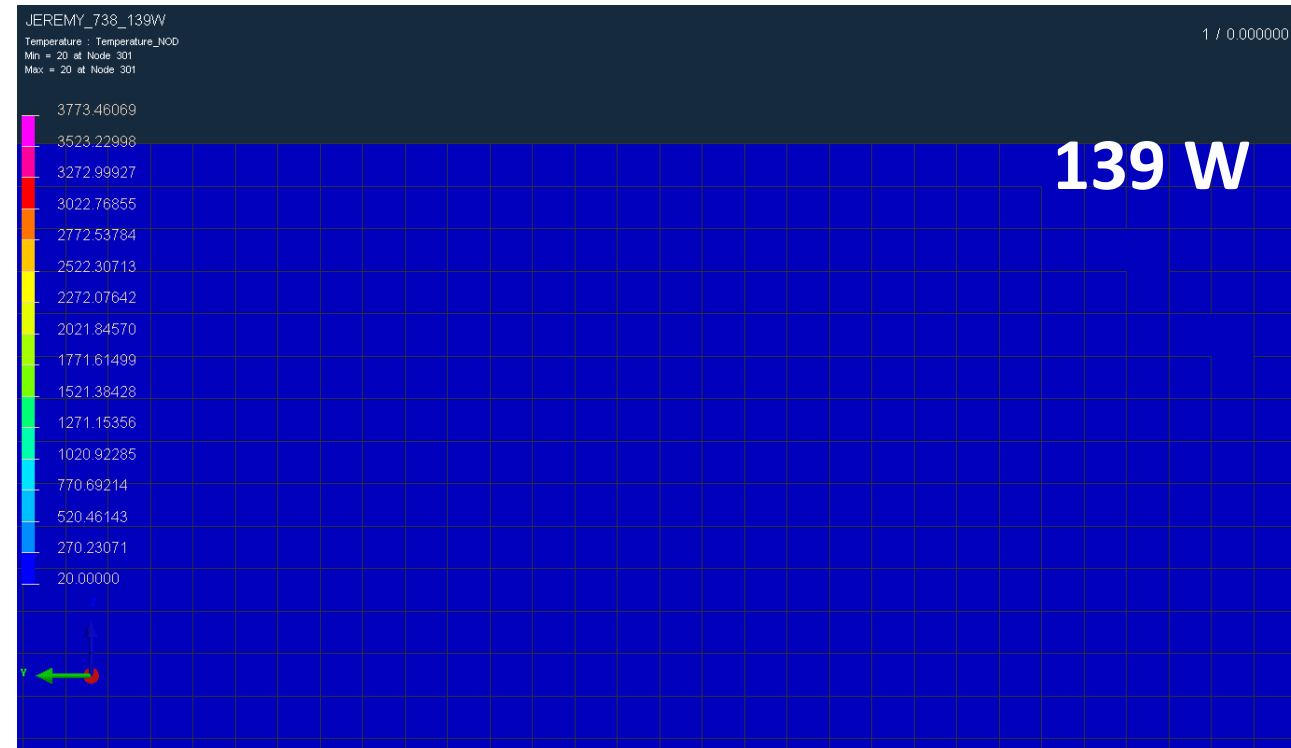
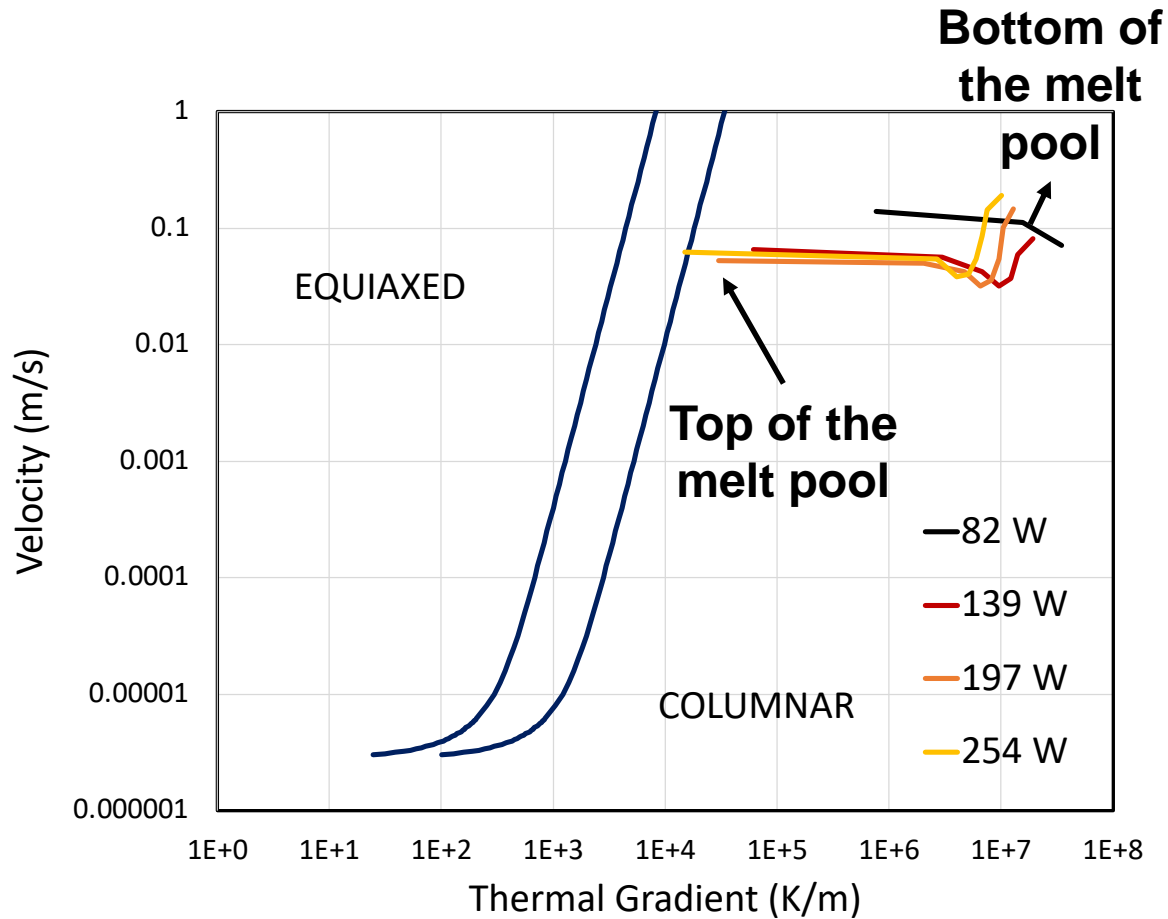


254 W



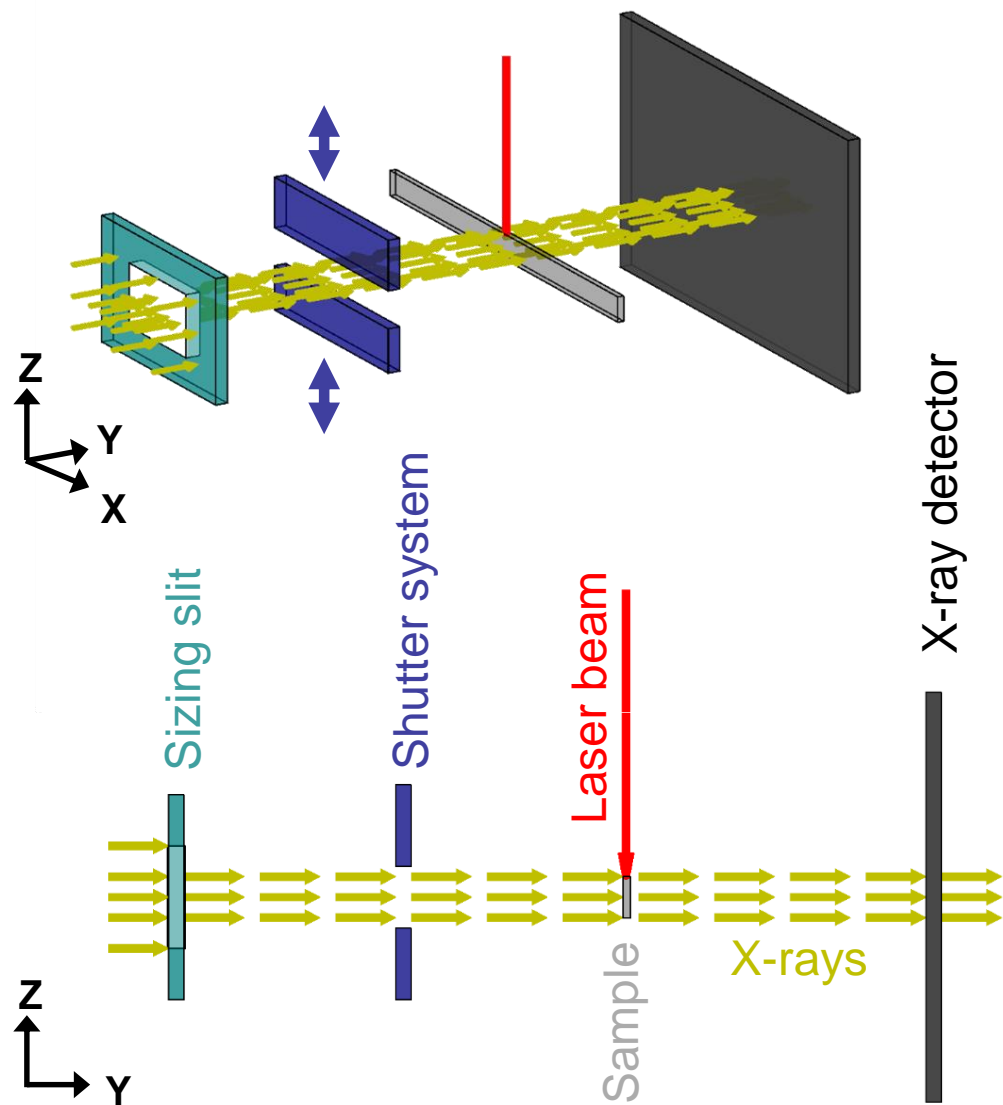
Additive manufacturing in non-ferrous alloys

In situ study of IN738 processed under different laser powers



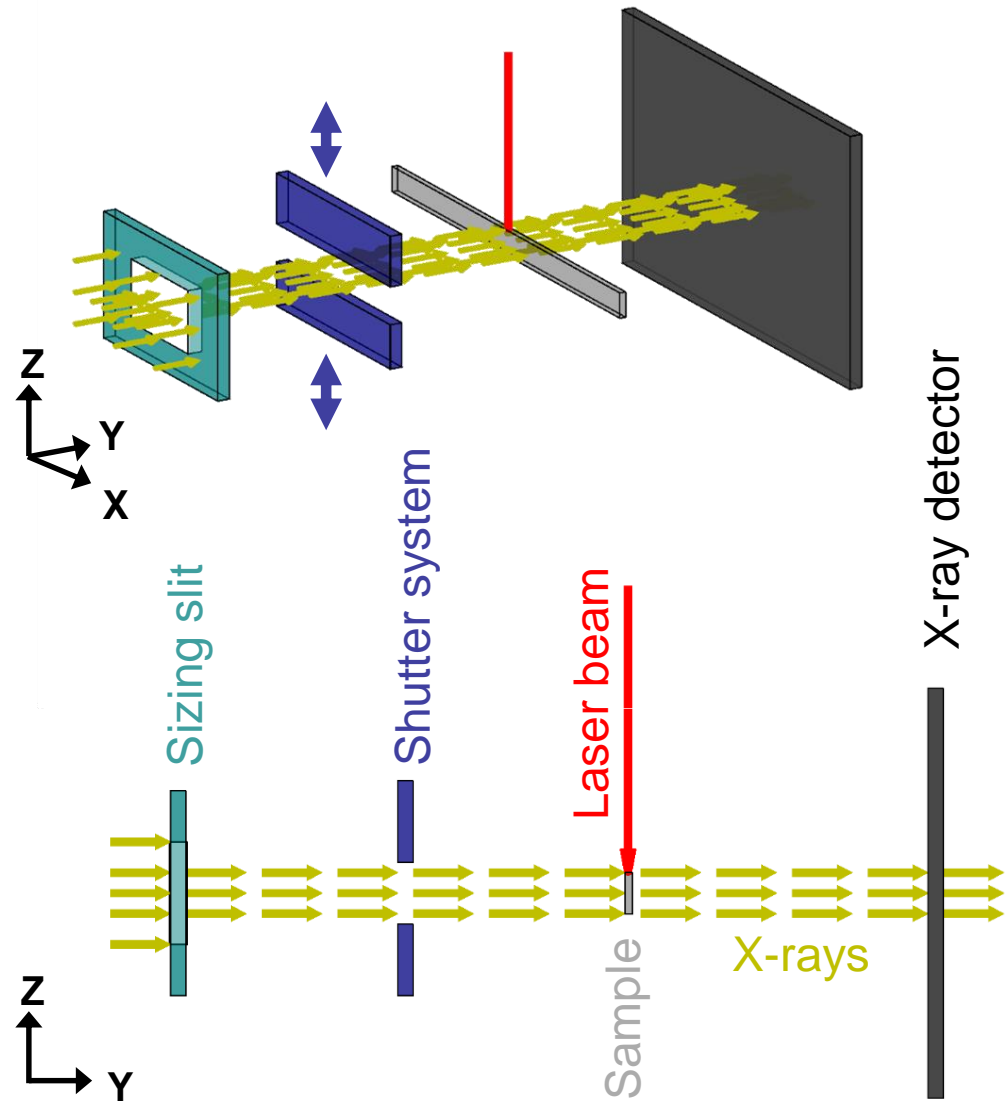
Additive manufacturing in non-ferrous alloys

Effect of the inoculation of Ta particles on the microstructure in pure Al

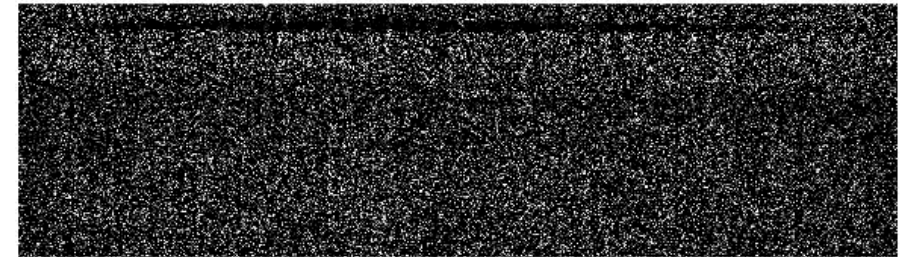
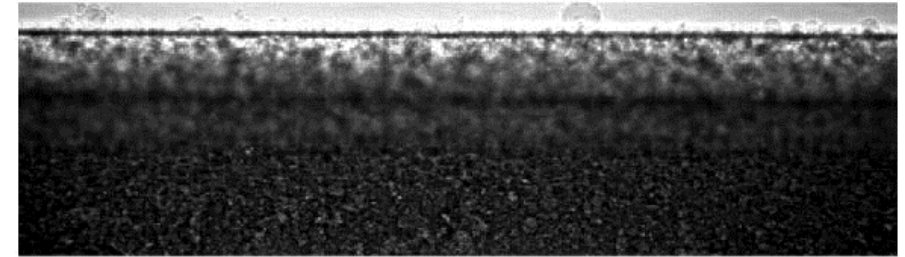


Additive manufacturing in non-ferrous alloys

Effect of the inoculation of Ta particles on the microstructure in pure Al



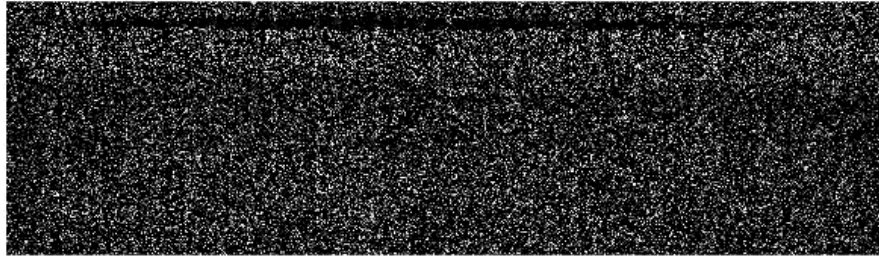
$t = 0.80 \text{ ms}$



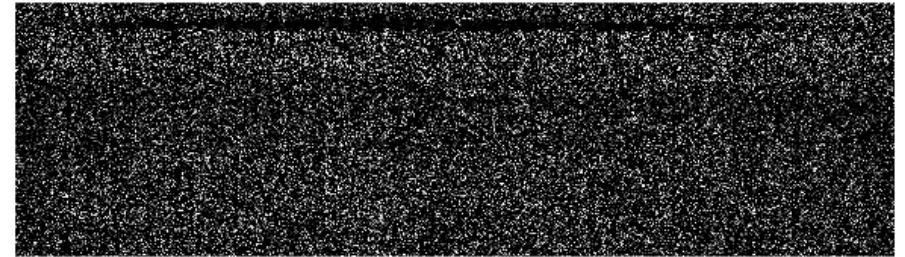
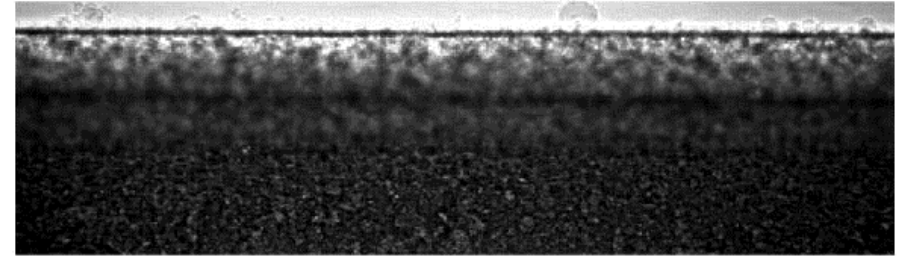
Additive manufacturing in non-ferrous alloys

Effect of the inoculation of Ta particles on the microstructure in pure Al

$t = 0.80$ ms



$t = 0.80$ ms



Challenges & Opportunities



Assessing the effect of power laser on LPBF microstructures in IN738

- Re-estimation of solidification velocities and calculation of its associated error
- Study of solute distribution at the melt pool and dendrite scales
- Study of gamma prime precipitation during subsequent heat treatments

Studying the effect of Ta particles on cracking susceptibility and grain refinement in pure Al

- Study of the effect of raster speed during rapid solidification
- Simulation of thermal conditions by Flow3D
- Microstructural characterization

Thank you!

Adriana Eres-Castellanos

erescastellanos@mines.edu