

Subject of the MapMod specialised master's degree in 2023

Date	May 22, 2023
TITLE	Modelling of rapid solidification paths
Project acronym	PY-PATH
Image (recommended)	
Image (recommended)	MARTIN et al., conference MCWASP, Banff, Canada, 2023
Caption of the image	Solidification path of the Inconel 718 nickel base superalloy as a function of the solid-liquid interface velocity showing (plain) non-equilibrium effects with increasing velocity departing from (dashed-dot) the case assuming interface thermodynamic equilibrium.
Thesis work description	<p>Safran Additive Manufacturing Campus is in charge to develop additive manufacturing processes for aeronautic applications. When using laser powder bed fusion of nickel base superalloys, solidification rate can reach more than 1 m s^{-1}. For such high velocity, non-equilibrium phenomena take place at the solid-liquid interface, such as solute trapping, solute drag and attachment kinetics. The classical physical metallurgy models assuming thermodynamic equilibrium at the interface no longer apply. To understand the role of the interface velocity on the solidification path, the PATH model is developed as part of the PhD work of Paul MARTIN at CEMEF, as illustrated by the figure. It is part of the PhysalurgY (PY) library.</p> <p>The objective of the project is to improve the model and to demonstrate its accessibility through a web-based graphical user interface.</p>
Type of project / Project partners	Additive manufacturing by laser powder bed fusion of nickel base superalloys
Type of project / Project partners	Industrial contract with company Safran Additive Manufacturing Campus

Objectives	<ul style="list-style-type: none"> - Reorganisation of the PhysalurgY (PY) modules for the calculation of rapid solidification paths <ul style="list-style-type: none"> ○ PY\PHDV : non-equilibrium phase diagram ○ PY\KIND : kinetics of dendritic microstructure ○ PY\PATH : rapid solidification path - Identification of the parameters required for the simulations - Rationalisation of input and output data of the modules - Adaptation for the graphical user interface - Analyses of the methodologies and parametric studies
Thematic / Industrial Field	Aeronautics
Key-words	Physical Metallurgy, Simulation, Thermodynamic, Additive Manufacturing, Solidification
Skills and abilities requested	Engineer or master
Gross annual salary	
Location	CEMEF, Sophia Antipolis, France Safran Additive Manufacturing Campus, Le Hallian, France
Contact, supervisor & research group(s)	Gildas Guillemot, 2MS Charles-André Gandin, 2MS Sélim KRARIA, CSM