EUROMAT 2021 / Area D

SYMPOSIUM: D9

Title: Modelling of Solidification, Casting, and Remelting

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Abstract

Modelling of solidification needs to respond to challenges posed by the optimization of existing processes, by new processes for lightweight and high-performance materials and structures, and by the development towards integrated materials design. Solidification is a multiscale and multiphysics phenomenon. Modelling of solidification processes thus encompasses phenomena that range from the atomic scale (nucleation, interfaces,...), over the microscopic (dendrites, eutectics, peritectics,…) and the mesoscopic scale (interactions of ensembles of grains, convection), up to the macroscopic process scale (heat & mass transfer, multiphase flow, macrosegregation, macrostructure, plasticity). Coupling of several scales is key to successful simulation for many applications. To address this challenge new models and approaches are developed.

This symposium is dedicated to numerical modelling and simulation of solidification and associated phenomena related to casting, welding, and remelting processing of metallic alloys, non-metallic materials, and composites. The topics of interest include, but are not limited to:

Modelling of processes

- Shape casting (sand casting, HPDC, thixo- and rheo-casting, lost foam, investment casting,...), ingot casting, continuous/semi-continuous casting (steel and nonferrous alloys), remelting processes (ESR, VAR,...), welding and soldering.
- Relations of processing/microstructure/properties.
- Through-process modelling.

Modelling of the underlying physical phenomena

- Microstructure evolution, e.g., dendritic growth, globular-to-dendritic transition, eutectics, peritectics, and intermetallics, columnar-to-equiaxed / equiaxed-to-columnar transition, convection and solid motion.
- Multiphase flow and heat & mass transfer, mushy zone rheology.
- Micro-, meso-, and macrosegregation.
- Stress and deformation, hot tearing, shrinkage, and porosity defects.
- Nucleation, fragmentation, grain refinement.
- Thermodynamics of solidification and melting.

Development of modelling methods

- Microscale (phase field, sharp interface, enthalpy based,...).
- Mesoscale (CA, envelope, granular, DNN, DEM based,...).
- Macroscale (process-scale models).
- Scale bridging: hierarchical (volume averaging, homogenization,...) and concurrent (embedded models).

Numerical methods with a focus on application to solidification models

- Discretization methods (FVM, FEM, FDM, meshless, SPH, LB, DEM,…).
- Coupling algorithms for multiphysics and multiscale solidification models.
- Artificial-intelligence based modelling.