



LMS Seminar

31 March 2022 at 2:00 pm

Jean Mandel room

Modeling of additive manufacturing at multiple scales

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ABSTRACT

Most of Additive Manufacturing (AM) are solidification processes. As a result of the phase transformations, usual metallurgical features of arc welding processes are found, e.g., textured structures, intergranular hot tears, deviation from thermodynamic transformation paths, . . . The seminar will present the research activities on modeling of additive manufacturing of the team 2MS at CEMEF. Started in 2014, the activity was developed based on an existing solution for arc welding processes, with a moving metal-gas interface as a result of convective thermo-hydraulic heat transfers. Extended to the Laser – Powder Bed Fusion (L-PBF) AM process of ceramics, it required implementation of the metal-gas surface forces and adaptation of the heat source and its interaction with the powder. The choice made was then to consider the powder as an equivalent medium. The so-called meso scale simulations are now multi-pass multi-layer and apply to nickel-base alloys, yet limited to a total of few millimeter track lengths. The presentation will include our recent efforts to couple meso scale simulations to large scale simulation of the grain structure in order to predict the texture of the built part, or at least of a representative elementary volume (REV). While the REV can be used as an input to predict mechanical properties and ultrasound propagations, the presentation will conclude on the directions taken to further benefit from the prediction of the structure to enhance a hot tearing criterion. Other current actions on modeling of AM will be briefly presented.

BIOGRAPHY

Charles-André GANDIN received a diplôme d'ingénieur and a diplôme d'études approfondies in materials science at the Institut National Polytechnique de Grenoble and a PhD ès sciences techniques from the Ecole Polytechnique Fédérale de Lausanne. He joined the Centre National de la Recherche Scientifique in 1999 and became directeur de recherche in 2010. He is based at the Centre de Mise en Forme des Matériaux (CEMEF) of MINES Paris – PSL where he coordinates the team Métallurgie, Mécanique, Structures et Solidification (2MS). He is active in the field of modeling of solidification processing with links to materials science, primarily for metallic alloys. This includes numerical simulation of microstructures and phase transformations, coupling with thermodynamic calculations and thermomechanical processing of materials. He coordinated his projet ANR jeune chercheur and two European Space Agency projects. He has supervised 38 PhD students and published over 100 scientific articles.