MODELING OF LIQUID METAL FLOWS DURING ASSEMBLY OPERATIONS AND CHARACTERIZATION OF THE PROPERTIES OF THESE METALS AT HIGH TEMPERATURES

Philippe Le Masson

ABSTRACT The assemblies of metallic materials can be made by welding, additive manufacturing or even sintering. Understanding operations covers several points. First, the input of heat and molten matter generates energy distribution and the flow of molten matter. Then, the metallurgical transformations (allotropic transformations, fusion, solidification…) lead to modifications of the intrinsic properties of materials (thermal, electrical, mechanical…). In addition, the molten material due to its composition and its gaseous environment sees its flow properties modified (surface tension, viscosity for example). Finally, the thermal evolution jointly with the metallurgical transformations induce mechanical consequences in terms of residual stresses and strains.

The simulation of assembly operations will therefore be built by integrating either in a multiphysical form phenomena of energy input (arc, laser, etc.) and material (fusion of powder, wire, etc.), or in a simplified form to couple thermal, metallurgical and mechanical phenomena. Simulation examples will be presented.

Emphasis will be placed on the choice of parameters at high temperatures, emphasizing their effect on the results. The lack of data in the literature has led us to propose experimental developments in order to characterize metallic materials in the molten state. Examples of property measurements will then be presented.