Numerical modeling of additive manufacturing: thermomechanical aspects

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Additive manufacturing by selective laser fusion of powder appears as a promising process to elaborate high performance parts. Numerical simulation is a valuable tool for understanding laser matter interaction as well as the main physical phenomena governing liquid flow and solidification. It allows determining the influence of the different process parameters, and defining appropriate process windows. The presentation will illustrate this point through different multiscale and multiphysics numerical simulations applied essentially to the LBM process (laser beam melting) for metals and ceramics. Another topic that will be addressed is the behavior of metals at very high temperature, which is critical in terms of predicting stresses in the neighborhood of the melting pool, and associated defects such as solidification cracking. On the basis of mechanical tests performed under resistive heating, and instrumented by non-contact measurement techniques, the use of inverse finite element methods allows identifying parameters of elastic-viscoplastic constitutive models.