

**Dissertation title:**

**Stress analysis in atmospheric plasma spraying process by submodelling technique**

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The use of numerical simulation is especially relevant for increase the understanding of the phenomena involved within the thermal spraying process, as well as the optimization and control of thermal spraying. A thermo-mechanical model of the coating build-up to analyze the residual stress generation under consideration of the heat and mass transfer and by a one-way coupled thermal-stress analysis is developed. In this model the temperature evolution during the thermal spray process in the region close to the coating is estimated. The following estimation of stresses induced during the process is performed using the temperature evolution. To obtain a model with enough resolution on the scale of the whole piece, which has dimensions of millimeters, without losing resolution on the scale of the coating, which has a thickness of microns, it is necessary to explore the temperature and stress generation mechanisms in a small volume region with a size close to a splat. Due to the complexity of the numerical simulation of coating build-up processes and computational limitations, a submodelling technique is presented in order to connect results between the different resolution scales of the whole piece, the coating and splat (macro-/meso-/microscopic), increasing the results accuracy at the level of a splat. Furthermore, different experimental methods have been employed for the validation of this proposed numerical simulation model. On the one hand, due to difficulties to determinate experimentally the temperature and stress profiles in-situ inside a piece, a new approach based in IR-thermography is developed to obtain experimental temperature results that are employed to validate the numerical simulations. On the other hand, the incremental high-speed micro-hole drilling and milling technique permits the measurement of the residual stress/depth profile.