# Structural Aluminum alloy processed by Laser Powder Bed Fusion (L-PBF): A fundamental understanding of cracking

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Minatec – salle Chrome 1

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**Abstract**: In this thesis, an analysis of the hot cracking susceptibility as a function of processing parameters and solute content modification is presented for the structural aluminum alloy 6061 (Al-0.8Si-1.2Mg wt%) processed by laser powder bed fusion (L-PBF). The hot cracking mechanism is identified as solidification cracking based on experimental observations in as-built microstructures. In agreement with previous works, cracks are found to occur at high angle grain boundaries and are preferentially located at the center of the melt pools. Using the Rappaz-Drezet-Gremaud (RDG) model combined with thermal calculations using Rosenthal analytical model, the location of hot cracks corresponds to the regions of highest mechanical solicitation during solidification. Hot cracking sensitivity maps are then developed to predict in a simple manner the variations of hot cracking susceptibility as a function of the first-order process parameters, namely the laser power and scanning speed and as well as for the preheating conditions. The predicted trends are qualitatively in agreement with the experimental observation. The results allow the impact of processing conditions on reducing hot cracking to be discussed and the work also identifies key metallurgical parameters that play a key role in hot cracking. In addition to cracking sensitivity to processing conditions, solute content modification is also studied using the modeling aspect of the work, which helps to suggest guidelines to reduce cracking.