

**FEM-based numerical simulation of laser cladding process using ABAQUS CAE**

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**Abstract**

The laser cladding process is an advanced manufacturing process used for surface modification and rapid prototyping. This study has been made to analyse the temperature distribution in the molten pool, the optimum process parameters required for high-quality cladding, and the analysis of residual stresses generated during the laser cladding process.

A 3D finite element (FE) model has been created to study transient thermal analysis in ABAQUS CAE using the DFLUX subroutine. Gaussian distribution heat source has been applied in this study. Element Birth and death technology has been used to exhibit the additive nature of cladding using Python script. In this study, single-layer cladding of 316 stainless steel has been created on the 316 stainless steel substrate material.

The temperature field results of the molten pool were validated with the experimental data. Meanwhile, the effect of process parameters like laser power, scanning speed, laser absorptivity and preheat temperature on the peak temperature of the molten pool was also analysed in this study. And the characteristics of the cladding show good agreement with the temperature profile. The thermal stress distribution in the cladding was also analysed in this study. The results show that the peak temperature of the molten pool increases with the increase of the laser power, laser absorptivity, and preheat temperature, while the increase in scanning speed shows a decrease in peak temperature.