Computational Dynamics of Laser Alloyed Metallic Materials for Improved Corrosion Performance: Computational Dynamics of Laser Alloyed Metallic Materials

Olawale Samuel Fatoba (Tshwane University of Technology, South Africa),

Abimbola Patricia Idowu Popoola (Tshwane University of Technology, South Africa)

Gabriel Ayokunle Farotade (Tshwane University of Technology, South Africa)

Sisa Lesley Pityana (National Laser Centre, CSIR, South Africa)

ABSTRACT

Laser alloying is a material processing method which utilizes the high power density available from defocused laser beam to melt both metal coatings and a part of the underlying substrate. Since melting occur solitary at the surface, large temperature gradients exist across the boundary between the melted surface region and underlying solid substrate, which results in rapid self-quenching and re-solidifications. Alloyed powders are deposited in a molten pool of the substrate material to improve the corrosion resistance of the substrate by producing corrosion resistant coatings. A 3D mathematical model is developed to obtain insights on the behaviour of laser melted pools subjected to various process parameters. Simulation with 3D model with different values of various significant processing parameters such as laser power, scanning speed and powder feed rate influences the geometry and dynamics of the melt pool, and cooling rates. It is expected that the melt pool flow, thermal and solidification characteristics will have a profound effect on the microstructure of the solidified region.