Selective laser melting is fast evolving into an industrially applicable manufacturing process. While components produced from high-value materials, such as Ti6Al4V and Inconel 718 alloys, are already being produced, the processing of multi-material components still remains to be achieved by using laser additive manufacturing. The physical handling of multi-material in a SLM setup continues to be a primary challenge along with the selection of process parameters/plan to achieve the desired results – both challenges requiring considerable experimental undertakings. Consequently, numerical process modelling has been adopted towards tackling the latter challenge in an effective manner.

In this paper, a numerical simulation based optimization study is undertaken to enable selective laser melting of multi-material tool inserts. A standard copper specimen covered by a thin layer of nickel is chosen, over which a layer of steel has been deposited using cold-spraying technique, such as to protect the microstructure of Ni during selective laser melting. The process modelled thus entails additively manufacturing a steel tool insert around the multi-material specimen with a goal of achieving a dense product while preventing recrystallization in the Nickel layer. The process is simulated using a high-fidelity thermo-microstructural model with constant processing parameters to capture the effect on Nickel layer. Based on results, key structural and process parameters are identified, and subsequently an optimization study is conducted using evolutionary algorithms to determine the appropriate process parameter values as well as processing sequence. The optimized process plan is then used to manufacture real multi-material tool insert samples by selective laser melting.

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