Towards the Development of Mathematical Model for Predicting Cold Spray Process Outputs for Polymeric Materials Using Regression Analysis

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Abstract

Cold spray technology is rapidly evolving as an alternative solution to traditional additive manufacturing processes, such as 3D printing and thermal spray, to construct desired products or perform spot repair without carrying out full replacement of precision parts in service. In contrast to thermal spray, cold spray does not involve melting of precursor material but uses supersonic speeds to accelerate particles through a nozzle and deposit them onto a substrate. While most notable findings on cold spray involve metals, it is possible to cold spray polymers by taking advantage of their combination of high performance, strength, modulus, and low weight, for application in the military and aerospace. In this work, we aim to demonstrate and enhance the understanding of cold spray for polymeric materials. Specifically, we will develop meaningful mathematical models based on regression analysis to design and optimize cold spray procedures tailored to specific polymeric requirements. Initially, we developed a composite design matrix by identifying critical process parameters and providing preliminary estimates of spraying limits for nylon 6 through experimental trials. Further work involves varying the parameters and recording response outputs towards the development of the model.

Keywords: cold-spray, polymer, mathematical model, design matrix

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