Quantitative Nondestructive Evaluation of Cold Spray Manufactured Aluminum Samples in Additive Manufacturing and Repair Applications

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ABSTRACT

Cold spray is a solid-state material deposition process used to repair a wide range of surface defects, including corrosion, wear, and erosion in a component. It uses high-pressure gas to accelerate tiny particles of metal powder to supersonic speeds, which are then deposited onto the surface of the component. Heat treatment is often performed on cold spray samples to improve the mechanical properties and microstructure of the deposited material. The purpose of this research was to evaluate the consistency of the NDT test results across CS repair samples before and after heat treatments. For this purpose, cold-sprayed aluminum 6061 alloy samples were manufactured. NDT measurements, such as longitudinal wave velocity and eddy current electrical conductivity readings, were taken on these CS samples at as-sprayed conditions, and then the samples were subjected to T6 heat treatment procedures. Further NDT tests were done between T6 treatment at two separate times (annealed and solution-aged conditions) and observed that NDT results obtained were correlated with the micro- structure changes in heat treated samples. Our findings, after comparing test results to microscopic analysis using SEM, show that electrical conductivity and ultrasound wave velocity measurement methods presented here, have the potential for being used as standard quality measurement methods to quantitatively assess cold spray products at every step of the manufacturing process.