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Active Thermography Technique for High-Entropy Alloy Characterization Deposited with Cold Spray Technique

Authors : Nazanin Sheibanian, Raffaella Sesana, Sedat Ozbilen

Abstract : In recent years, high-entropy alloys (HEAs) have attracted considerable attention due to their unique properties and potential applications. In this study, novel HEA coatings were prepared on Mg substrates using mechanically alloyed HEA powder feedstocks based on Al_(0.1-0.5)CoCrCuFeNi and MnCoCrCuFeNi multi-material systems. The coatings were deposited by the Cold Spray (CS) process using three different temperatures of the process gas (N2) (650°C, 750°C, and 850°C) to examine the effect of gas temperature on coating properties. In this study, Infrared Thermography (non-destructive) was examined as a possible quality control technique for HEA coatings applied to magnesium substrates. Active Thermography was employed to characterize coating properties using the thermal response of the coating. Various HEA chemical compositions and deposition temperatures have been investigated. As a part of this study, a comprehensive macro and microstructural analysis of Cold Spray (CS) HEA coatings has been conducted using macrophotography, optical microscopy, scanning electron microscopy with energy-dispersive X-ray spectroscopy (SEM+EDS), X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), microhardness tests, roughness measurements, and porosity assessments. These analyses provided insight into phase identification, microstructure characterization, deposition, particle deformation behavior, bonding mechanisms, and identifying a possible relationship between physical properties and thermal responses. Based on the figures and tables, it is evident that the Maximum Relative Radiance (ΔRMax) of each sample differs depending on both the chemical composition of HEA and the temperature at which Cold Spray is applied.

Keywords : active thermography, coating, cold spray, high- entropy alloy, material characterization
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