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Cold Spray High Entropy Alloy Coating Surface Microstructural Characterization and Mechanical Testing

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Abstract : High Entropy Alloy (HEA) coatings of Al0.1-0.5CoCrCuFeNi and MnCoCrCuFeNi on Mg substrates were prepared from mechanically alloyed HEA powder feedstocks and at three different Cold Spray (CS) process gas (N2) temperatures (650, 750 and 850°C). Mechanically alloyed and cold-sprayed HEA coatings were characterized by macro photography, OM, SEM+EDS study, micro-hardness testing, roughness, and porosity measurements. As a result of mechanical alloying (MA), harder particles are deformed and fractured. The particles in the Cu-rich region were coarser and more globular than those in the A1 phase, which is relatively soft and ductile. In addition to the A1 particles, there were some separate Cu-rich regions. Due to the brittle nature of the powder and the acicular shape, Mn-HEA powder exhibited a different trend with smaller particle sizes. It is observed that MA results in a loose structure characterized by many gaps, cracks, signs of plastic deformation, and small particles attached to the surface of the particle. Considering the experimental results obtained, it is not possible to conclude that the chemical composition of the high entropy alloy influences the roughness of the coating. It has been observed that the deposited volume increases with temperature only in the case of Al0.1 and Mg-based HEA, while for the rest of the Al-based HEA, there are no noticeable changes. There is a direct correlation between micro-hardness and the chemical composition of a coating: the micro-hardness of a coating increases as the percentage of aluminum increases in the sample. Compared to the substrate, the coating has a much higher hardness, and the hardness measured at the interface is intermediate.

Keywords : characterisation, cold spraying, HEA coatings, SEM+EDS
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