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SOLID PARTICLE EROSION ASSESSMENT OF FLAME-SPRAYED HIGH ENTROPY ALLOY COATINGS

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ABSTRACT

High entropy alloys (HEAs) are classified as novel metallic alloys that have received significant attention owing to their peculiar microstructural features and exceptional material properties. HEAs are characterized by the mixing of five or more principal elements in equiatomic concentrations with stabilized phases. However, the benefits of HEAs coupled with thermal spraying technologies has been unexplored to encounter extreme environments. In this study, novel equiatomic AlCoCrFeMo, AlCoCrFeMoW and AlCoCrFeMoV HEA compositions were fabricated using cost-effective flame spraying techniques. Microstructural and mechanical characterization was carried out using scanning electron microscopy (SEM), X-ray diffraction (XRD), and micro-indentation techniques. Furthermore, performance assessment using a modified version of ASTM Standard G76 particle erosion testing was conducted at controlled temperatures and at constant stand-off distance and impingement angle. Microstructure of the HEA coatings revealed high fraction of oxides with solid solution structure. Due to the oxide evolutions, hardness showed noticeable variation, where AlCoCrFeMoV showed highest hardness values followed by AlCoCrFeMoW and AlCoCrFeMo HEA coatings. Lower erosion rates were achieved for AlCoCrFeMoV compared to AlCoCrFeMoW and AlCoCrFeMo, which is explained based on their microstructural features and oxide formations. Post erosion analysis using SEM was also conducted for all the coatings to understand the damage mechanism under simultaneous thermal loading. These results indicate the efficacy of flame-sprayed HEA coatings under extreme mechanical and thermal environments, which can be potentially transformative for addressing different tribological features for industrial sustainability.

Keywords: Flame spray, High Entropy Alloys (HEAs), Microstructure, Solid-Particle Erosion, Wear Resistant Coatings.

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