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Mechanical Investigation Approach to Optimize the High-Velocity Oxygen Fuel Fe-Based Amorphous Coatings Reinforced by B4C Nanoparticles

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Abstract : Fe-based amorphous feedstock powders are used as the matrix into which various ratios of hard B4C nanoparticles (0, 5, 10, 15, 20 vol.%) as reinforcing agents were prepared using a planetary high-energy mechanical milling. The ball-milled nanocomposite feedstock powders were also sprayed by means of high-velocity oxygen fuel (HVOF) technique. The characteristics of the powder particles and the prepared coating depending on their microstructures and nanohardness were examined in detail using nanoindentation tester. The results showed that the formation of the Fe-based amorphous phase was noticed over the course of high-energy ball milling. It is interesting to note that the nanocomposite coating is divided into two regions, namely, a full amorphous phase region and homogeneous dispersion of B4C nanoparticles with a scale of 10–50 nm in a residual amorphous matrix. As the B4C content increases, the nanohardness of the composite coatings increases, but the fracture toughness begins to decrease at the B4C content higher than 20 vol.%. The optimal mechanical properties are obtained with 15 vol.% B4C due to the suitable content and uniform distribution of nanoparticles. Consequently, the changes in mechanical properties of the coatings were attributed to the changes in the brittle to ductile transition by adding B4C nanoparticles.

Keywords : Fe-based amorphous, B_4C nanoparticles, nanocomposite coating, HVOF
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