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MECHANICAL INVESTIGATION APPROACH TO OPTIMIZE THE HVOF FE-BASED AMORPHOUS COATINGS REINFORCED BY B4C NANOPARTICLES

Behrooz Movahedi
University of Isfahan, Iran

Fe-based amorphous feedstock powders used as the matrix into which various ratios of hard B_4C nanoparticles (0, 5, 10, 15, 20 vol%) as a reinforcing agent 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 B_4C nanoparticles with a scale of 10–50 nm in a residual amorphous matrix. As the B_4C content increases, the nanohardness of the composite coatings increases, but the fracture toughness begins to decrease at the B_4C content higher than 20 vol%. The optimal mechanical properties are obtained with 15 vol% B_4C 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 B_4C nanoparticles.

b.movahedi@ast.ui.ac.ir