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A study of processing and slurry erosion behaviour of multi-walled carbon nanotubes modified HVOF sprayed nano-WC-10Co-4Cr coating

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Abstract

In the present research work, multi-walled carbon nanotubes (MWCNTs) were mixed with WC-10Co-4Cr nanostructured feedstock powder in order to study its effect on the slurry erosion behaviour of as-sprayed coating. The deposition of coatings was performed by using a high velocity oxy-fuel (HVOF) spray gun (Praxair TAFA JP-5000). Jet-type slurry erosion testing was performed to study the erosion performance and behaviour of as-sprayed and CNTs modified nano-WC-CoCr coatings. Important coating properties such as porosity, micro-hardness, surface roughness and indentation fracture toughness have been measured. The surface morphology of thermal spray powders, deposited coatings and worn-out surfaces has been studied by using scanning electron microscopy (SEM) images. The worn-out surfaces revealed that the material was removed by micro-cutting and ploughing of CoCr matrix, leading to the loosening and pull-out of WC grains in case of 30º impingement angle erosion testing. The 90º impingement angle erosion testing resulted in fracturing of WC grains followed by eruption of binder matrix by interlinking of cracks originated from fractured WC grains. The introduction of MWCNTs improved the fracture toughness of nano-WC-CoCr coating by 'splat-bridging' feature. The introduction of MWCNTs favoured the plastic deformation around the bridging by supressing the brittle fracture of coating material. The increase in fracture toughness resulted in enhancement of erosion resistance of MWCNTs modified nano-WC-CoCr coating.

Keywords: HVOF; Nanostructured; CNT; Erosion; WC-CoCr; Coating