ABSTRACT

Thermally sprayed coatings from nanostructured agglomerated ceramic powders have received considerable attention in recent past due to their improved performance over corresponding coatings from conventional powders. When complete melting of a fraction of agglomerated particles is prevented, unmelted and partially melted (PM) particles appear as inclusions within the fully melted matrix resulting in a *bi-modal* coating microstructure. In addition to uniform mixing of constituents, the enhanced performance of nanostructured coatings has also been attributed to above described bi-modal nature of the microstructure. Interestingly, even though nitrogen is cheaper and more widely available than argon, essentially all earlier works on plasma spraying of nanostructured coatings use argon as the primary plasma gas.

In this work we systematically study the effect of critical plasma spray parameter (CPSP), which controls the specific power input to the plasma gas, on microstructural and wear characteristics of three most widely used nanostructured coatings: Al_2O_3-13wt%TiO_2, WC-17wt%Co, and ZrO_2-7wt% Y_2O_3, deposited by air plasma spraying using nitrogen as the primary plasma gas. For comparison purpose, nanostructured alumina-titania coatings were also deposited using air plasma spraying with *argon* as the primary plasma gas and nanostructured tungsten carbide-cobalt coatings were deposited using high velocity oxy-fuel spraying with propane as the fuel gas. Several important findings were made in this work. Higher specific enthalpy of nitrogen, at a given gas temperature, was seen to result in lower percentage of PM regions and α-alumina content in nanostructured alumina-titania coatings deposited with nitrogen. More importantly, CPSP was found to have *only* a small effect on coating microstructure as well as its wear characteristics in nanostructured alumina-titania coatings deposited with nitrogen. On the other hand, CPSP had a significant effect on wear performance of corresponding coatings deposited with argon. In nanostructured WC-Co coatings deposited by air plasma spraying with nitrogen as the primary plasma gas, due to significant decarburization tungsten rather than tungsten carbide was found to be the dominant phase in these coatings. Among nanostructured yttria stabilized zirconia, coatings deposited at highest CPSP exhibited best wear performance.

Key words: Thermal spray**;** Plasma spray; Nanostructured coatings; Wear tests.