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The Faculty of Mechanical Engineering and Aeronautics

Abstract of doctorate thesis

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Thermal spraying technologies are widely used in the aerospace industry, including for the manufacturing and refurbishment of components exposed to intensive service wear. Their importance is also increasing due to restrictions on hard chromium plating resulting from environmental regulations and health hazards associated with hexavalent chromium. In this context, the development of alternative technologies for producing coatings with high tribological resistance is an important research direction.

The aim of this doctoral dissertation was to determine the influence of selected High Velocity Atmospheric Plasma Spraying (HV-APS) process parameters, using a three-electrode Axial III plasma torch, on the structure and properties of cermet carbide coatings and to determine the relationships between their microstructure, chemical and phase composition, mechanical properties, and tribological behaviour. The properties of a selected coating produced by HV-APS were also evaluated in comparison with a coating of the same material composition produced by the High Velocity Oxy-Fuel (HVOF) process.

The results demonstrated that the properties of HV-APS coatings depend on both the process conditions and the type of coating material used. Differences in microstructure, phase composition, mechanical properties, and tribological behaviour were identified, together with partial degradation of carbide phases. It was also demonstrated that the relationships between microstructure, microhardness, and wear resistance are complex and depend on the dominant wear mechanism. The type of coating material had a significant influence on its response to HV-APS process conditions and, consequently, on the resulting functional properties. Compared with the HV-APS technology, the coating produced by HVOF exhibited more favourable structural and mechanical properties and greater resistance to erosive wear, whereas the HV-APS coating showed a lower abrasive wear rate. The obtained results indicate that HV-APS using the Axial III plasma torch may constitute complementary or alternative solution to HVOF for selected applications.

Keywords: thermal spraying; HV-APS plasma spraying; Axial III plasma torch; HVOF; carbide coatings; cermet coatings; coating microstructure; carbide decarburization; tribological properties; abrasive wear; microhardness; surface engineering; wear-resistant coatings; aerospace applications