HVOF coatings as an alternative to hard chrome for pistons and valves

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Abstract

Automotive manufacturers have specified chromium plating for decades because of its appearance, wear and corrosion resistance, however chromium plating cause effects on human health because of the use of substances in the galvanic process whose toxicological features have not always been recognised. The improvements of the High-Velocity-Oxy-Fuel thermal spray process achieved by Thermico, allow the chromium coating replacement with a comparable or superior surfaces and more environment friendly. The present study describes and compare the mechanical and tribological properties of the conventional and nanostructured HVOF CrC75 (NiCr20) 25 coatings and the conventional hard chromium plating. The objective of the present work is applying this new nanostructured HVOF coating in piston rings and valve stems applications. Furthermore, the studied HVOF coatings are produced with micro and nano-powders in order to avoid the blasting and regrinding operations necessary when plasma spray coatings are used. The coating microstructures were characterised by SEM microscopy. Differences in roughness have been determined by profilometry. The ultra-microindentation technique was applied to measure the hardness and the elasto-plastic properties of the coating. Experiments using a pin on disc tribometer under lubricated and dry conditions have been performed in order to evaluate the friction and wear properties of the different coatings. It was found that the CrC-NiCr coatings obtained with the lowest feedstock powder size presented the best wear resistance under all the studied conditions. The Nano CrC-NiCr coatings have demonstrated superior performance to hard chrome with regard to mechanical and tribological properties, and they can be proposed as an alternative to hard chrome coatings.

Keywords: HVOF thermal spraying, CrC-NiCr coatings, Microhardness, Tribology, Hard chrome alternatives.