Development of plasma-sprayed zirconia coatings

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Abstract

Various layers of zirconia coated on cast iron plates and steel discs by plasma spraying. Micro hardness was studied to get a better understanding of their mechanical behavior. Coatings selected for this investigation were zirconia-5% CaO, Zirconia-8% yttria, zirconia-20% yttria and alumina zirconia coatings.

Keywords: Plasma-spray coatings; Phase transformation; Microhardness

Introduction

As of late, warm shower innovation has been broadly utilized for warm obstruction coatings and wear-resistance coatings [1]. Fired materials connected as warm boundary coatings have been effectively considered and created since the 1960s. Thermal boundary coatings are connected to burning framework segments, for example, cylinders, valves, and cylinder lire decks in diesel engine [2]. Different warm shower coatings have likewise been contemplated for application to cylinder rings to progress their wear protection [3]. HVOF-showered nickel chromium/ chromium carbide, plasma-showered molybdenum/ chromium carbide, and plasma-showered chromium oxide demonstrated enhanced wear protection as a cylinder ring covering contrasted with electroplated chromium [4]. Sliding of self mated, plasma-showered, incompletely balanced out zirconia showed better wear performance. Sliding against a metallic substrate [5] and 8% Y_20_3-ZrOs, 20% Y_2O_3-ZrO_2, and Al_2O_3-ZrO_3coatings were found to have better wear protection looked at than cast press that is at present utilized as barrel liners [7]. The fiction coefficients of these coatings, notwithstanding, were observed to be equivalent to or then again higher than that of cast press under dry, reacting to sliding conditions where the. Counter face material was electroplated chromium. A few works have likewise imported the wear of warm splashed coatings in dry sliding. Wear behavior of plasma-splashed 8% Y_2O_3coatings, led in a reacting to sliding analyzer at a temperature of 200^oC, was influenced by plastic distortion and material exchange [8]. In comparable test led at higher temperatures up to 800^oC. Dehumidifying and stage change from monoclinic to tetragonal significantly influenced the wear conduct of plasma-sprayed8 % Y_2O_3- ZrO_2 coatings [6]. While the fundamental wear mechanisms of plasma-sprayedroom: coatings were plastic misshaping, break arrangement because of weakness and brittleRatter [l0]. Various plasma-sprayed ceramic coatings (Cr_2O_3- 5% SiO_2-3% Ti, Cr_3C_2% Ni-3% Cr, TiO_2, WC-18% Co, ZrO-20% Y_20_3 and Al_2O_3,) have been studied in a roller-on-block tester at 450^oC and the wear mechanisms for all of these coatings were. Reported to be fatigue spelling, plastic deformation and material transfer, as in metals [9]. On the other hand, the wear mechanism of plasma-sprayed Cr2O3-25% NiCr coatings was dominated by abrasion and strain fatigue in a pin-on-disk two-body abrasion test [10].Since zirconia-based ceramics have been used in engines and gas turbines as thermal barrier coatings, plasma spraying of these materials onto cylinder liners could enhance the thermal efficiency of internal combustion engines and increases the service life of piston ring/cylinder liner pairs. The remaining task, in this case, is to improve the friction behavior of these coatings. Therefore, modification of surface property of the counter face material is necessary if plasma-sprayed, zirconia-based coatings are to be used as cylinder liners.

The overall goal of this research is to evaluate the possibility of applying plasma-sprayed zirconia-based coatings as piston ring coatings as well as cylinder liner coatings and identify their friction and wear behavior. In the present study, we employed a bench test technique which simulates the reciprocating motion of a piston ring against the cylinder liner.

Experimental procedure

The concoction arrangements of the substrate materials, SUM24L for the plate example and FC25 cast press for the plate example. Examples were machine-ground and uhrasonicatly cleaned before being coarseness impacted by alumina rough (AC24 work) to guarantee great bond of the covering layer to the substrate. Before splash covering, a Ni-Cr-Al-Co-Y composite (METCO461 powder) was applied as a bond coat to enhance bond and decrease warm development bungle between the substrate and covering layer. Thothsickness of the bond coatings was around 70µm all things considered. The examples were covered with different zirconia-based earthenware powders. Both the coatings and the bond layer were plasma showered utilizing a MBTCO9MB plasma showering machine, following the parameters prescribed by the providers. The surfaces of the examples subsequent to showering were ground with up to 600 coarseness emery paper to limit unpleasantness variety between examples. The inside line normal (CLA) surface unpleasantness of artistic covered examples. Estimated with a Talysurf-6 profilometer was in the scope of 1 & l.4 µm, while the chromium-plated circles and cast press plates had surfacroeug hnesses in the range of 0.12-O.16 µm and 0.45-0.6 µm, respectively. The thickness of ceramic coatings was around 200 µm except for the zirconia 8% yttrium coating (denoted as TB) which had a thickness of around 370µm. The thickness of the chromium plate was about 165 µm. It was shown that the effect of plasma-sprayed coating thickness on the wear rate is negligible if the coating thickness is in the range 180-200 µm or greater [7].

Results

Fig. 1 shows the micro hardness of as-sprayed coating layers as a function of coating depth. Marked differences in micro hardness were observed depending on the starting powder. There seemed to be some correlation between the hardness and microstructure. The zircon & 8%yttria (TB) coating exhibited the highest micro hardness. The local fluctuation in the micro hardness was believed to be due to the variation in local structure due to the pores or lamellae boundaries.

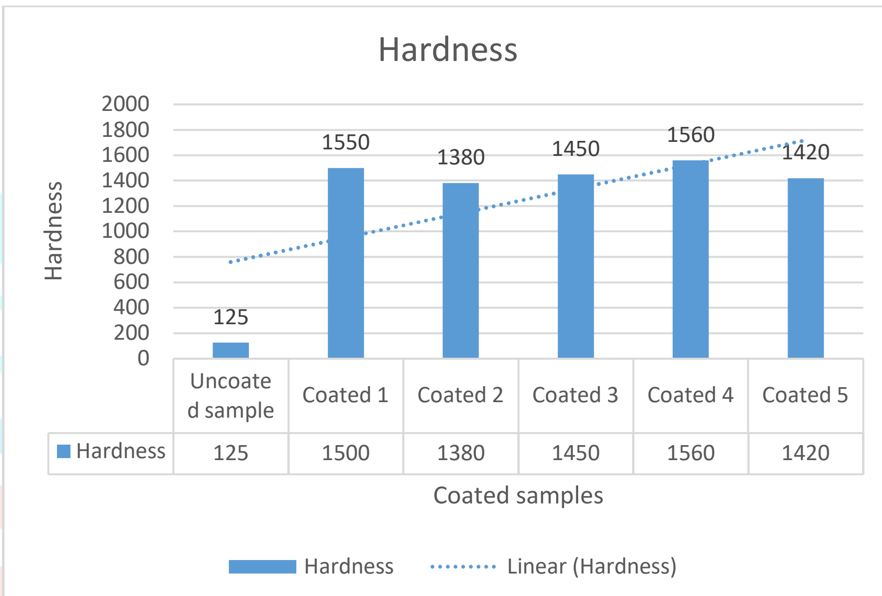

Fig. 1 Micro hardness of as sprayed coating

Conclusion

To gain abetter understanding of thetribologicalbehaviourof plasma-sprayed zirconia-based coatings, experimentaltests were performed and analysis of the worn surfaces wereconducted.

1. The micro hardness of coatings is closely related to the wear of coatings. The zirconia-8% yttrium (TB) and t&tmina-zirconia coatings exhibited higher hardness and possessed bettor wear properties than the coatings which had lower hardness.

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