Scientific Journal of Impact Factor (SJIF):
e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 5, Issue 04, April -2018

CHARACTERIZATION OF PLASMA-SPRAYED CHROMIUM OXIDE COATING

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Abstract - *A plasma-sprayed chromium oxide coating was developed to attain better tribological properties and wear performance. A smooth surface films were formed by plastic deformation of the coating. The significant amount of CrO_3 was detected at room temperature though $CrO_2$was distinguished at 4508C. CrO_2 in the smooth film appears to be ideal than CrO_3 in increasing microhardness and wear performance. The dominant species with carbon-related bonds in the film was distinguished as graphite at both room temperature and high temperature. Among the compound formed in the film, graphite appears, to be most critical in determine the micro hardness of the film*

Keywords: *Plasma-sprayed Cr_2O_3 coating; Micro hardness.*

Introduction

Thermal sprayed coatings have huge consideration as wear-resistance coatings and among these is the plasma-sprayed chromium oxide coating [1– 4]. Plasma sprayed chromium oxide coatings, directed in a reciprocating sliding tester at room temperature, showed enhanced wear resistance as a cylinder ring coating compared with electroplated chromium in diesel engine [1]. A self mated sliding of chromium oxide covering showed preferable better performance over cast iron/chromium-plate pairs in both wear and friction under reciprocated dry sliding at room temperature and 4508^{o}C [2]. The primary wear mechanism of plasma-sprayed ceramic coatings were accounted for to be plastic deformation, crack development and spalling because of fatigue and material exchange [5, 6]. For plasma-sprayed chromium oxide coatings, comparable wear mechanism was accounted for under dry sliding condition [3, 4] and, a part of wear resistance film framed by plastic deformation of adhered and compacted debris particles was discussed [4]. The investigation of dry sliding wear, the investigation of tribological behavior related to the lubricated sliding of chromium oxide coatings is much deficient. An examination of self-mated chromium oxide covering lubrication with water, which contained a particular surfactant, for example, lithium stearate and magnesium stearate decreased both the wear and friction due to an adsorbed film formed at first glance [7]. A chromium oxide coating combined with a plasma-sprayed molybdenum coating was contemplated with a manufactured ester oil [8]. The graphite films, formed by the synergist splitting of the hydrocarbon segments in the grease, were credited to the lessening in the wear and contact. It was likewise revealed that the tribochemical protective film must be formed when satisfactory added substances were utilized as a part of block-on-ring test of self-mated chromium oxide covering [9].

Experimental Procedure

The chemical compositions of the substrate materials, SS41 steel for the disc and FC25 boron cast iron for the plate, are given in Table 1. FC25 boron cast iron cylinder liners, used in medium-duty diesel engines, were cut to fabricate the plates. The disc specimens were 10 mm in diameter and 4 mm thick whereas the dimension of the plate specimens was 4*38*58 mm. Specimens were machine-ground and ultrasonically cleaned before being grit blasted by alumina abrasive a to ensure good adhesion of the coating layer to the substrate.

Prior to spray coating, Ni–Cr–Al compositeMetco 443NS powder; Ni 85 wt. %, Cr 14.1 wt. %, Al 6.1 wt. %. was applied as a bond coat to enhance adhesion and reduce thermal expansion mismatch between the substrate and coating layer. The thickness of the bond coatings was less than 30 mm. The specimens were coated with METCO-136F powder SiO_5 wt. %, TiO_3 wt. %, CrObalance. Both the coatings and the bond layer were plasma-sprayed using a Miller SG-100 plasma spraying gun at the spraying condition shown in Table 2.

The surfaces of the specimens after spraying were ground with up to 600-grit emery paper to an average roughness value of 0.25 mm R for the plate specimens a and 0.2 mm R for the disc specimens.

Table 1 Chemical Composition

Composition	C	Si	Mn	P	S	Cr	Pb	Cu	B	Fe
Cast iron	3.16	2.35	0.66	.21	.08	.19	-	.25	.065	Bal

Table 2 Plasma spraying condition

Parameters/Coatings	Cr_2O_3 coating	NiCrAl bond coating
Gun type	Miller Sg 100	Miller Sg 100
Arc gas pressure(kPa)	344.7	344.7
Powder gas pressure (kPa)	344.7	275.8
Current	900	900
Gun speed (mm/s)	500	1000
Hoper RPM	3.2	1.5
Spray distance (mm)	75	70

Results

Experimental tests were performed and investigations of the worn surfaces were led to pick up a superior comprehension of the tribological behavior of plasma-sprayed Cr_2O_3 coatings. The microhardness values under dry sliding condition have appeared in figure 1. The micro hardness of the film formed at 4508^{o}C is appeared to be impressively higher though that of the film formed at room temperature was marginally lower than that of the as-ground surface.

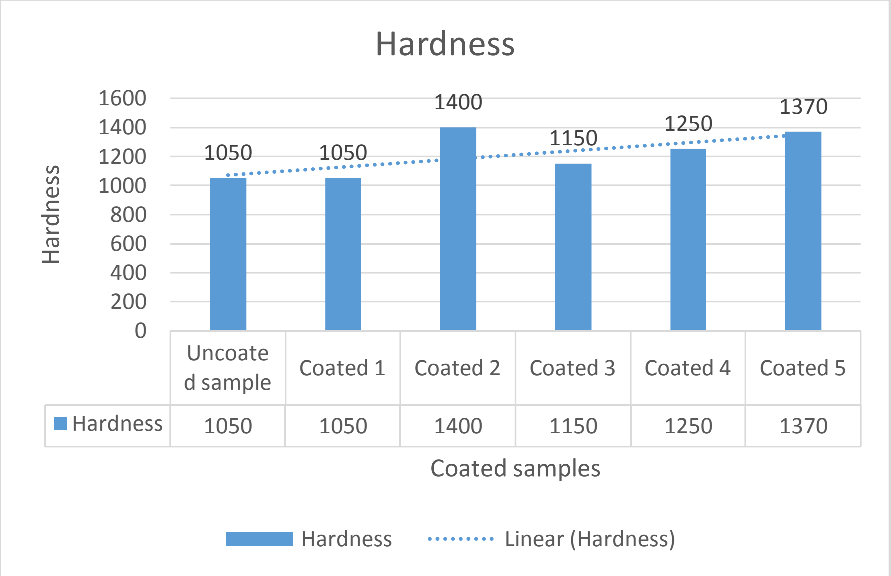

Figure 1 Micro hardness ofplasma-sprayed Cr_2O_3 coatings

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