Tribological Comparison of Nanocoatings on Diesel Engine Cylinder Liner

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The tribological effect of reduced graphene oxide (rGO) coated engine cylinder liner by electrophoretic deposition process (EPD) is compared with the chromium nitride (CrCN), titanium nitride (TiN) and diamond like carbon (DLC) coatings on the cylinder bore using Physical Vapour Deposition (PVD) process for low friction, better lbubricity and high wear-resistance. Their tribological performance was evaluated through a reciprocating tribometer, using steel ball (100 CR6) on a rGO, CrCN, TiN and DLC coated cylinder liners with 5W-40 engine oil to investigate their wear and friction behavior in boundary lubrication regime. Tribotests showed less friction in 4mns of EPD coating of rGO related to CrCN, TiN and DLC coating. One of the main reasons is that the hardness of rGO is less than CrCN, TiN and DLC.

Keywords: Liner Coating, Nanocoatings, rGO, EPD

1. Introduction

It is essential to have least frictional forces present in between mating and/or reciprocating components. High coefficient of friction leads to higher wear rate affecting the engine life. Besides, mechanical friction has significant effect on the internal combustion (IC) engine fuel economy. There is a pressing need to reduce these frictional losses to improve overall efficiency of the engine, reduce oil consumption and to increase life of engine [1]. RGO, CrCN, TiN and DLC coatings were applied on the surface of Diesel engine cylinder liner.

2. Methods

The sleeve liner has been cut precisely (10X13X10 mm) and was coated with rGO using EPD process. RGO has been prepared using chemicals such as 2-propanol and magnesium nitrate hexahydrate in colloidal form. CrCN, TiN and DLC were coated on cylinder bore using Physical Vapour Deposition (PVD) process in the industry.

2.1. Results

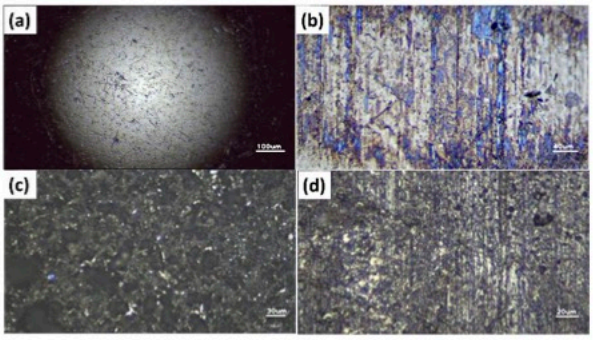

Figure 1: Microscopic examination of the ball (a and b) and liner (c and d) surfaces before and after tribotest.

Figure 1 presents the microscopic examination of the ball and liner surfaces before and after test. Coefficient of Friction (COF) results were presented in "Figure 2". RGO coating showed the minimum COF and protected well the surfaces of sliding pairs.

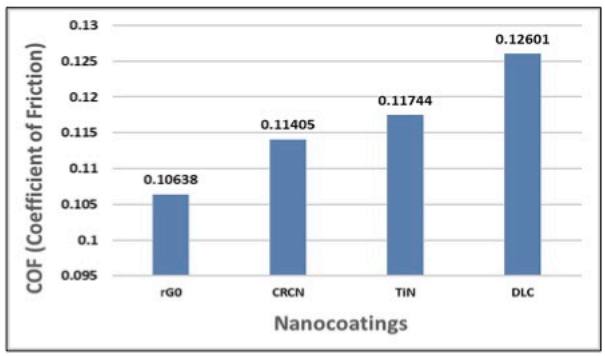

Figure 2: Friction coefficient of rGO, CrCN, TiN and DLC coated cylinder liners.

The surfaces as well as all additives were analyzed through optical microscopy, SEM-EDX and AFM. The accumulation of carbon (C) derived from the derivatives of graphene was heavily detected on the rubbed surface of ball/liner.

3. Discussion

Restuccia *et.al.* expressed that graphene is an excellent coating for low friction and wear. They concluded that iron coating by graphene is extremely effective at reducing the intrinsic resistance to sliding of iron interfaces. Therefore, the graphene coating is able to passivate the iron surfaces very effectively the metal-metal interaction at the interface [2].

4. References

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