TRIBOLOGICAL BEHAVIOR OF CrN COATINGS DEPOSITED BY RAAMS UNDER LUBRICATED RECIPROCATING RING ON PLANE CONDITION

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KEYWORDS
Coating; Friction; Experiments in tribology, Sliding wear

ABSTRACT
Ceramic coatings are designed to improve friction and wear behavior for tools, gears and engine components, but some deposition processes may lead to an increase on surface roughness mainly by the presence of coating defects [1]. In a lubricated system under high contact loads and boundary lubrication regime, those defects can promote surface/subsurface damage of the material, leading to premature failure of the system [2]. In addition, fully formulated lubricants are designed to operate under metal contacts, with the possibility of losing performance under non-metal or ceramic coating contacts [3]. In this work, an innovative reactive deposition process called Remote Anode Assisted Magnetron Sputtering (RAAMS) was used to produce 4 µm thick CrN coating on polished AISI H13 tool steel substrates, which were previously quenched and tempered. Fig.1 shows SEM image (JSM 6010-LA from JEOL Ltd.) and 3D roughness evaluation (CCI AMETEK Inc.) of the as deposited CrN. The roughness parameter Sa was 0.026 µm for coated and uncoated samples.

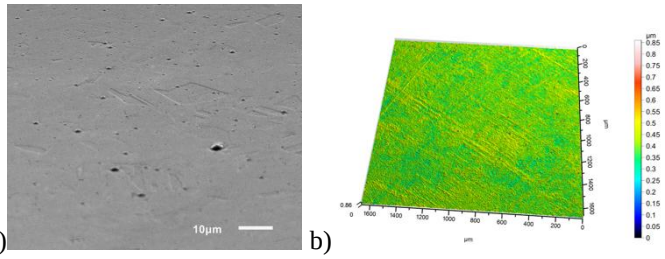

Fig.1 SEM images of surface (a) and cross-section (b) of the CrN deposited by RAAMS technique.

The tribological behavior was analyzed using a reciprocating test rig (SRV v4 from Optimol Instruments Prüftechnik GmbH) on a ring on plane configuration. The ring was a commercial nitrided cast iron with a diameter of 75 mm. Ramping normal loads were tested (5 N to 50 N in steps of 5N for 10 min.) with a stroke of 4 mm and frequency of 10 Hz. Both coated and uncoated samples were tested using SAE 0W20 fully formulated synthetic oil (FFSO) at 120ºC. Also, SAE PAO-8 was used with an uncoated sample to stablish a base line case.

Fig. 2 shows time average COF behavior based on 3 replicas for each condition. In this figure, CrN lubricated with FFSO presented lower friction results compared to uncoated sample with PAO-8 case for a wide range of normal loads (5 to 30 N), approaching similar friction results for higher loads. The lower friction results for uncoated sample lubricated with FFSO may be promoted by the presence of oil additives designed to work with metallic surfaces, suggesting a non-reactive tribo-chemistry system between oil additives and CrN coating.

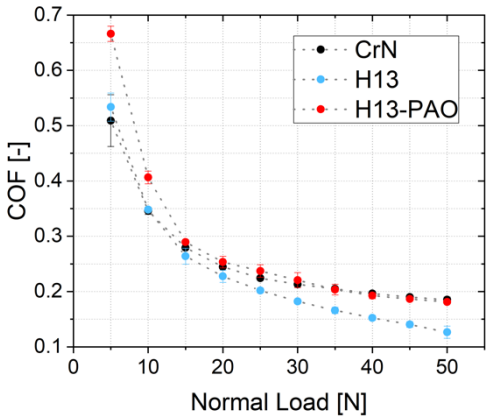

Fig.2 Coefficient of friction behavior during the reciprocating tests for CrN (black) and uncoated (red and blue) samples. Black and blue circles were tested with fully-formulated oil while red circles were tested with PAO-8.

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