Study of chromium nitrate coating prepared by RF/DC magnetron sputtering

R.Hariharan , R.Raja , R. Agash Raj, E.A. Agathiyan, D. Deva, P. Esakki

Abstract*: *The reasonable solution to the requirement of semi solid forming tools and low melting point metals and alloys while using chromium nitrate coating (CrN). This type of hard coating to have excellent mechanical behaviour when working at high temperature. We will develop the related hard coating based on stainless steel. This method is obtained by RF / DC microwave sputtering on HSS substrate (high-speed steel). The multilayers are characterized in terms of their hardness, wear, corrosion resistance. The films showed the [200] most well-liked orientation at lower (at 20%) nitrogen contents whereas the intensity of the height [111] will increase with the rise within the nitrogen content. The Cr_2N (220) peak was known at a chemical element content on top of half-hour, but for chemical element content on top of four-hundredth, the CrN section was ascertained in each films deposited on Si(100) and glass substrates. The well-liked orientations of the CrN thin films area unit strongly influenced by the chemical element content within the chamber as ascertained within the gift ok. The chromium-metal interlayer through the film structure enhances the coating of the steel by reducing current, mobility, the better coefficient of thermal expansion.

Keywords: CrN;XRD; RF/DC magnetron sputtering;HSS; multilayers.

1.INTRODUCTION

Surface And Coating Technology 97 (1997) - Industrial usage of CrN covering, spared at high and low temperatures – (VB. NAVINSEK P. PANJAN, I. MILOS) the CrN covering system has been analyzing comprehensively finished the latest 10 years. Result exhibit that the available sworn statement methodology allows the declaration of CRN hard covering with radiant disintegration and wear properties.

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WEAR 290 – 291 (2012) 149 – 153 - Corrosion wear of CrN multilayer covering stored on AIAI stainless steel utilizing the uneven magnetron sputtering framework – ALEGRIA-ORTEGA, L.M. OCAMPO-CARMONA) The consumption conduct of CrN multilayer covering delivered by unbalancing Magnetron sputtering over stainless steel and over uncovered steel was considered utilizing the strategy. The outcome demonstrated that the aggregate wear rate could be decreased significantly as for exposed stainless steel when sort of covering is utilized. Surface And Coating Technology 146-147 (2001) 268 – 273 - Multi-Layered Chromium/Chromium Nitrate covering for use in weight bite the dust throwing – (A. Lacasa, J. Romero, E. Martinez, J. Esteve, L. Carreras)Chromium nitrate covering are known to give sensible answer for the necessities of semisolid framing apparatuses and of weight kick the bucket throwing of low softening point metals and compounds .we have built up a related hard covering in view of multi-layered stacking of crN .The crN metal interlayer and the multilayer film structure enhance the bond of the covering.

Surface And Coating Technology/(1999) 1152 – 1160 - Erosion of CrN and TiAlN coatings under chloride-containing conditions (L. Cunha A,*M. Andritschky A, L. Rebouta A, K.Pischow B) CrN physical Vapor statement systems, on the stainless steel substrate and consumption conduct. X-beam photoelectron spectroscopy was utilized to contemplate the system of the responses that happened in the vaporous condition. The watery consumption conduct of the nitride coatings is unequivocally reliant on the micro defect thickness of the covering.

surface and covering tech. 120-121 (1993) 213 – 218 - A comparative depiction of aluminum oxide coatings unbroken by RF,DC and beat open thermionic vacuum tube sputtering (R. Cremer a,*, M. Witthaut a, D. Neuschu¨ tz

a, G.Erkens b,T. Leyendecker b)The hardness of sputtering condition upon the precious stone structure of the films has been inspected by x-pillar optical phenomenon, happening declaration rate and crystallinity. Low oxygen fractional weight while none of the picked procedure parameters brought about the arrangement of crystalline.

Surface and Coatings Technology 201 (2006 CrN coatings (Harish C. Barshilia, N. Selvakumar, B. Deepthi, K.S. Rajam)structural and mechanical properties of the coatings were depicted mistreatment X-beam optical phenomenon (XRD) and nanoindentation systems, completely. The holding structure of the coatings was pictured by X-beam negatron spectrographic analysis (XPS). The surface morphology of the coatings was thought of victimisation checking research|microscopy} (SEM) and nuclear power microscopy (AFM). The XRD information showed that the CrN and CrAlN coatings showed B1 NaCl structure.) 2193– 2201 - an in depth examination of responsive electrical energy vacuum tube sputtered CrAlN and Applied Surface Science 253 (2007) 5076– 5083 - Nanolayered multilayer coatings of CrN/CrAlN orchestrated by open DC vacuum tube sputtering (Harish C. Barshilia a,*, B. Deepthi a, N. Selvakumar associate degree, Anjana religious belief b, K.S. Rajam) Single-organize CrN and CrAlN coatings were place away on atomic number 14 and swish steel substrates employing a responsive DC vacuum tube sputtering system. The helper depiction of the coatings was done victimisation X-beam optical phenomenon (XRD). The XRD information exhibited that the multilayer coatings were consistent up to a temperature of 650℃ and apexes distinctive with Cr2O3 started showing at 700℃. These results were confirmed.

Details of CrNx coating synthesized by solid thin film 517 (2009) 1887-1894 - DC and beat DC magnetron sputtering (Hayashi, ZL Wu, XH Zhang, B. Mishra, and JJ Moore, WD unequal closed magnetic field magnetron sputtering stand flow velocity Using a different flow velocity flow rate of nitrogen flow velocity ff 2 2) chromium-metal oxide, nitriding,

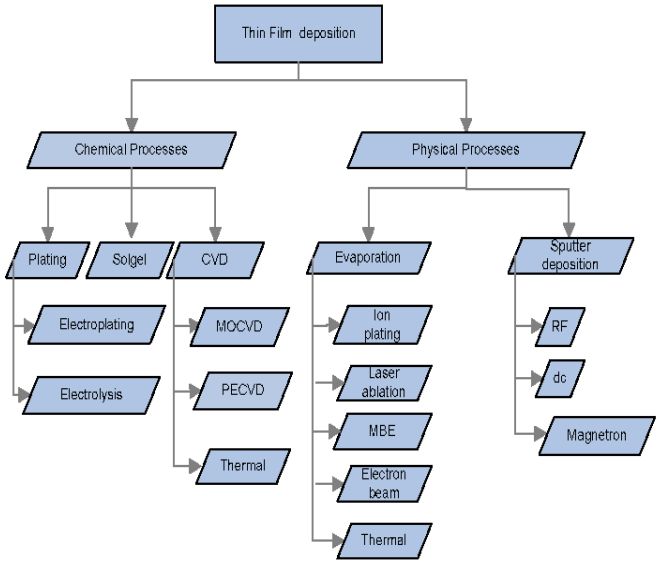


Fig 1. Techniques for Thin-Film Deposition

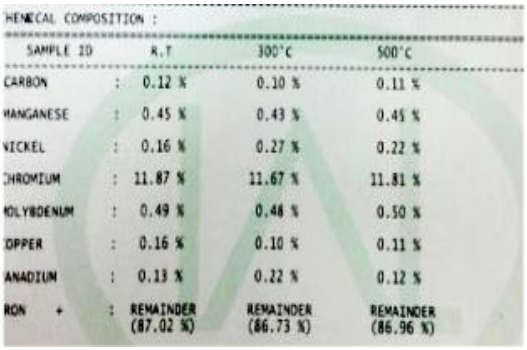
Deposition parameters	Values
Target	99.99% Cr
Substrate	M2 Steel
Base pressure	< 4 X 10-6 Torr
Working pressure	10 mTorr
Target power density	75 W (3.82 W/CM2)
Distance between target and substrate	7 CM
Temperatures	RT,300ºc,500 º c
Deposition time	1 Hr

Table 1. The process parameter of deposition of the CrN by RF/DC

2. RESULT AND DISCUSSIONS

2.1 CHEMICAL COMPOSITION

A sample of a M2 corrugated plate is exposed to a chloride-containing environment. The chromium nitride ratio and the appearance of the sample are given (see Figure 2.1). A lower Cr ratio leads to more corrosion. Specific Procedures were developed by Material Interface to capture the surface chemistry of these samples. The analysis can also be performed according to the specifications published in ASTM E 1916,IS228



HEMICAL COMPOSITION :

SAMPLE ID		R.T	300°C	500°C
CARBON	:	0.12 %	0.10 %	0.11 %
MANGANESE	:	0.45 %	0.43 %	0.45 %
NICKEL	:	0.16 %	0.27 %	0.22 %
CHROMIUM	:	11.87 %	11.67 %	11.81 %
MOLYBDENUM	:	0.49 %	0.48 %	0.50 %
COPPER	:	0.16 %	0.10 %	0.11 %
VANADIUM	:	0.13 %	0.22 %	0.12 %
IRON	:	REMAINDER (87.02 %)	REMAINDER (86.73 %)	REMAINDER (86.96 %)

Fig 2.1 wet chemical analysis for RT, 300 °C, 500°C

2.3 CORROSION ANALYSIS

The samples coated with TiN where under salts spray test for 12 hours. The concentration of sodium chloride was 5.3% NaCl and the temperature in the chamber was 34.1C to 34.7 the pH of the salt solution was 6.9 and air pressure was 15 psi. After 12 hours of salt spray test it was observed that there was no corrosion. From the data acquired, Corrosion resistance of high-speed steel (M2) has been increased RT,300°C,500°C.

2.3 WEAR PROPERTIES

The coated samples had less corrosion and the substrate coated at 500 ° C showed the best corrosion resistance for the coating tested in the tests. The wear resistance and corrosion resistance of high speed steel has been increased by CrN coating

2.4 COMPOSITION AND STUCTURE OF CrN /HSS FILM

2.4.1 RAMAN EFFECT

We estimate that some natural stages that are artificially present amid film development add to the watched tops. Since the natural stage is shaky athightemperatures, these pinnacles vanish in the strengthened movies. The anatase period of CrN advances by toughening the movies at RT. For RT-toughened movies, just the most extreme pinnacle or anatase structure comparing to the (101) reflection shows up. Different pinnacles or anatase structures couldn't be distinguished on the grounds that they were beneath the commotion level.

High-temperature examination (300 ° C) brings about the development of the vintage stage and the presence of an expansive number of pinnacles comparing to this stage. The diffraction example of the film settled at 500 ° C contains pinnacles of both anatase and rutile stages, demonstrating the event of the change to a guide stage in the vicinity of 300 and 500°C.

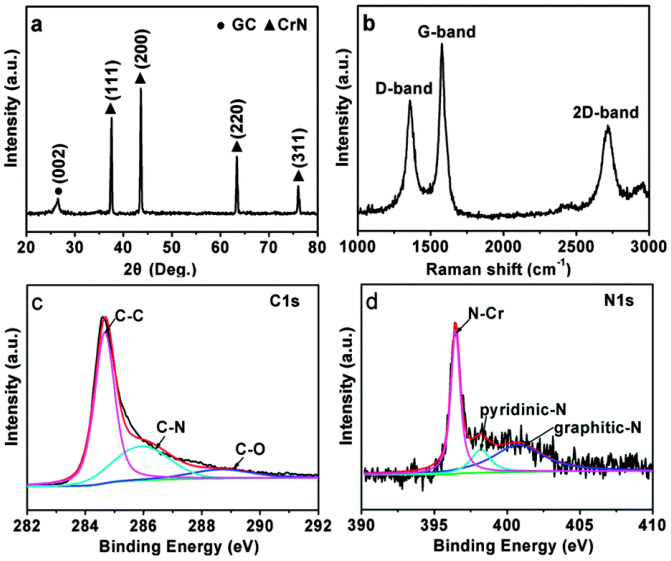


Fig 2.4.1 Raman microstructure analysis

2.4.2 AFM

The surface topographic characterization was done in my atomic force microscopy. The AFM scan was performed on three CrN-covered samples at room temperature, 300 ° C and 500 ° C for 20 nm, 120 nm and 80 nm, respectively. The scan was performed with semi-contact on sputtered CrN for a scan area of 5 µm. m × 5 µm m performed on the surface. From the AFM images (see Fig.2.4.2 a, b, c) titanium surface have average roughness of 2.36641 nm, 14.741 nm and 12.8364 nm for room temperature, 400°C and 600°C temperature coatings respectively. From the results found it can be determined that due to the low average roughness, there will be low friction co-efficient decreasing the wear on the worm gear.

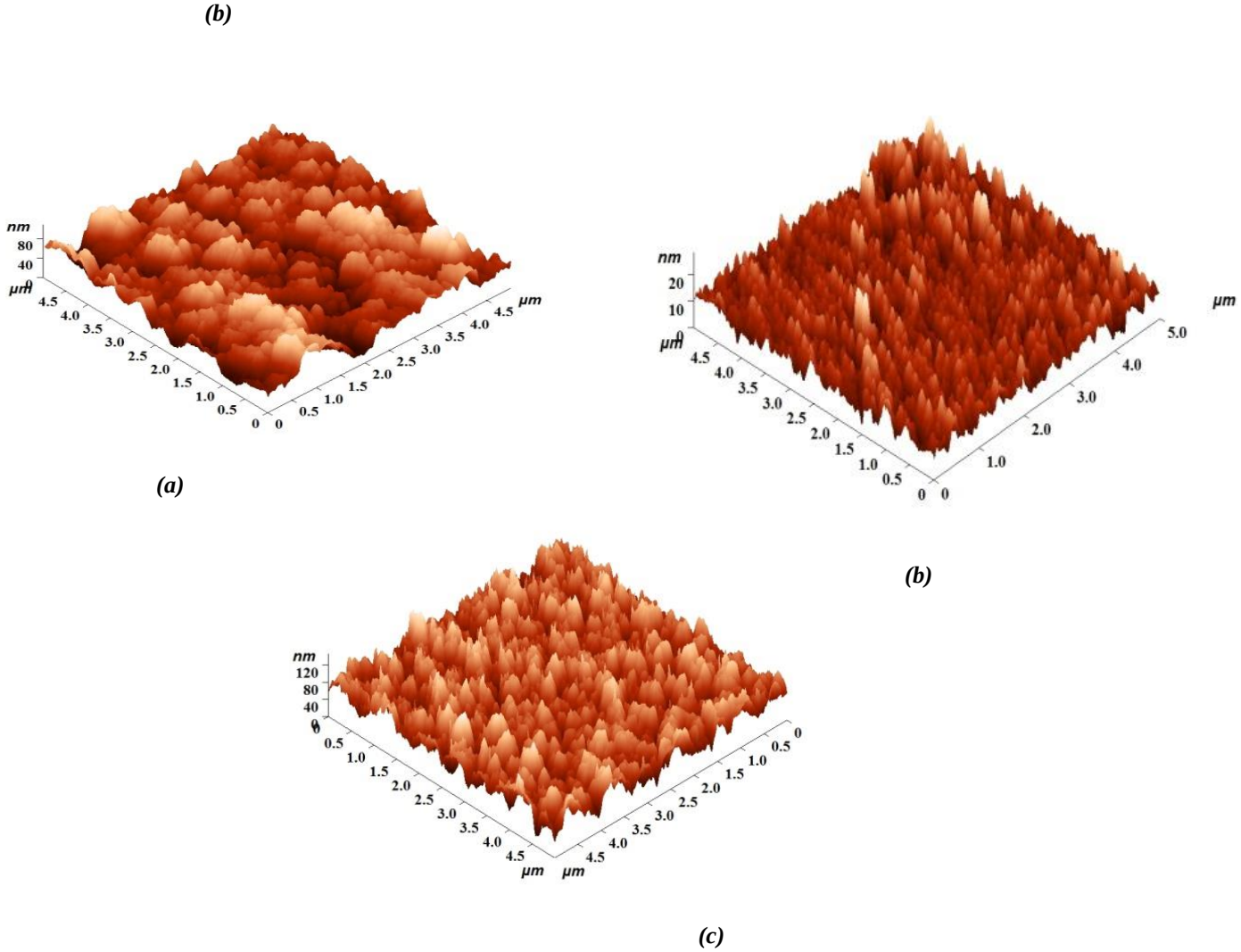


Fig 6.4.2 (a) 5μm × 5μm 3D Image of Coated Sample at Room, (b) 5μm × 5μm 3D Image of Coated Sample at 300°C Temperature, (c) 5μm × 5μm 3D Image of Coated Sample at 500°C Temperature

2.4.3 MICRO STRUCTURE

The surface that has been inscribed with picric acid showed selective corrosion at the previous γ grain boundaries is discovered metallurgic magnifier METSCOPE-1A. The nominal grain size that was resolute from microscopic images in the view of 100 micro meters by the cutting method (refer Fig 2.4.3 a,b,c).The micro structure reveled porosity observed 18-20%,4-5% and 4-5% of porosity during the temperature of RT,300°C and 500°C.

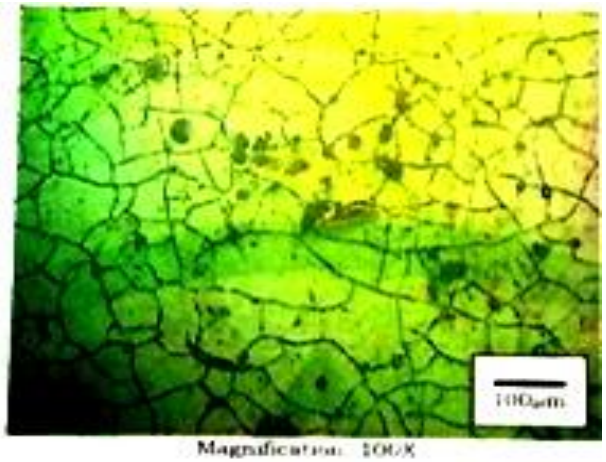


Fig 2.4.3 (a)

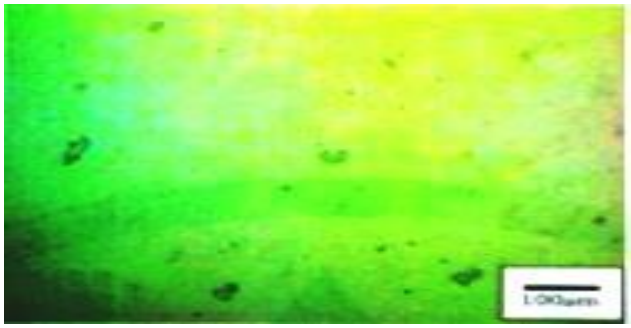


Fig 2.4.3 (b)

Fig 2.4.3 (c)
Fig 2.4.3 Microstructure analysis of (a) RT (b) 300°C (c) 500° C

CONCLUSION

We investigated the influence of oxygen midpoint weight and substrate temperature on the structure and hardness of the chromium thin film, similarly because the testimony quantitative relation, on RF electron tube sputtering. The procedure window for the affidavit of crystalline CrN is resolved for every one of the three strategies and a relationship between's the O-stream Speed from one aspect and testimonial speed as substrate temperature and hardness is determined to the contrary side. The coatings stored by methods for RF innovation demonstrated an especially high hardness. In spite of the fact that the RF sputter coatings have better hardness esteems thought about than the DC and intermittent electron tube sputtering films, this affidavit strategy experiences low stores and costly RF procedures. In this manner, the magnetron sputtering procedure seems to supply an affordable discount between film quality and frugal film generation. The results from this work can be laid out as takes after:

(1) Examination of the consumption instrument of chromium mixes in HCl-containing climates at raised temperatures demonstrates that the harm to the surface is caused by the gas misfortune and the subsequent concoction response. The substance response rate is higher than anticipated from basic oxidation estimations, while it isn't the forceful air. The 12-hour erosion examinations won't harm the layer at a profundity in the vicinity of 3 and 6 nm. On CrN coatings, the hot consumption analyzes likewise demonstrate a noteworthy gas misfortune and a substance response of Cr and N.

(2) The fluid consumption insurance is diminished by the pores and gaps that give the reaction to the substrate or layer. In any case, it has additionally been demonstrated that even a thin yet thick layer, for example, E can fundamentally enhance the consumption properties.

(3) The destructive assault of the vaporous specialists by the hot consumption mulls over the reason for the erosion of the surface, for the most part of the bronze substrate material and the consecutive covering delamination. The coating of CrN was found to resist somewhat stronger attacks from Cl-containing carriers than the coating of CrN. Coatings with atiny low gap or pore thickness area unit extremely prospering. To stay away from this impact in an extremely conservative strategy additionally ponders on multilayer coatings can be completed.

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