International Journal of Psychosocial Rehabilitation, Vol. 23, Issue 03, 2019
ISSN: 1475-7192

Study of Chromium Nitrate Coating Prepared by RF/DC Magnetron Sputtering

R. Hariharan and R. Raja

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 sputtering state on the crystal structure of the films is examined by X-ray diffraction (XRD), AFM (atomic force microscope), SEM (Scanning Electron Microscope), hardness by micro penetration. 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.*

I. INTRODUCTION

The first-generation CrN coatings in individual layers (CrN Cub and Cr2N hexagonal) are used as protective coatings because they have good abrasion resistance. To improve these CrN clothing characteristics, many researchers researched alloys with another metal to form a ternary hard layer (Al, Si, V ...).

In addition to the essential requirements of resistance to wearing, it is more desirable that the substrate provides improved resistance to corrosion, especially against Cl (marine environment). The article presents the corrosion analysis and resistance performance of a single layer of CrN coating deposited by PVD of reactive electron beam.

1.1 Chromium Nitrate (CrN)

Chromium nitrate describes various inorganic compounds consisting of chromium, nitrate and various amounts of water. The most common is the dark hardness, but also an anhydrous green form is known. Chromium nitrate compounds have limited commercial interest and find some applications in the paint industry. In academic laboratories it is common to synthesize chromium coordination.

1.1.1 Properties

Anhydrous salts form green crystals and are soluble in water (unsaturated chromium chloride dissolves very slowly unless under special conditions). Decompose at 100°C. Red purple hydrate is easily soluble in water. Chromium nitrate is used to produce alkali metal-free catalysts and drill bits. Chromium nitrate can be obtained by dissolving chromium oxide in nitric acid.

R. Hariharan, Research Scholar, Department of Mechanical Engineering, BIST, BIHER, Bharath Institute of Higher Education & Research, Selaiyur, Chennai. E-mail: mech.hariharan17@gmail.com
R. Raja, Professor, Department of Mechanical Engineering, BIST, BIHER, Bharath Institute of Higher Education & Research, Selaiyur, Chennai.

Received: 19 Feb 2019 | Revised: 07 Mar 2019 | Accepted: 02 Apr 2019

1.1.2 Structure of Chromium Nitrate

The relatively complicated formula: [Cr (H2O) 6] (NO3) 3 • 3H2O - emphasizes the complex structure of this material. Chromium centers are connected to six bodies of water, and the remaining solid volume is occupied by three nitrates and three crystallization water molecules. These complex formulations characterize hydrated metal salts.

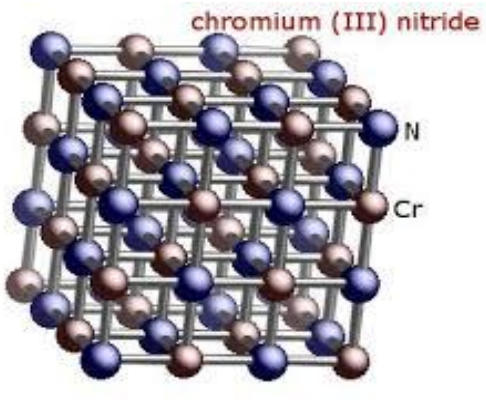


Fig. 1.1: Chromium Nitrate Structure

1.1.3 Application, Advantage of CrN

Compound Properties

The accompanying tables list the compound properties of chromium nitrate nanoparticles..

Chemical Data	
Chemical symbol	$Cr(NO_3)_3$
CAS No	7789-02-8
Group	Chromium6 Nitrogen15 Oxygen 16
Electronic configuration	Chromium[Ar]$3d^5 4s^1$ Nitrogen[He]$2s^2$ $2p^3$ Oxygen [He] $2s^2$ $2p^4$
Chemical Composition	
Element	**Content (%)**
Chromium	21.85%
Nitrogen	17.65%
Oxygen	60.50%

Physical Properties

Chromium nitrate nanoparticles show up as violet precious stones. The table underneath gives the physical properties of these nanoparticles.

Properties	Metric	Imperial
Density	1.8 g/cm^3	0.065 lb/in^3
Molar Mass	400.15 g/mol	-

Applications

The following are the chief applications of chromium nitrate:

- In the dying industry
- For the synthesis of chromium coordination complexes.

1.2 High Speed Steel (HSS)

Quick Steel (HSS) may be a bit of composite steel usually used in tooling and cutting mechanical assemblies. It's customarily used in watched sharp edges and exhausting apparatuses. It's higher than the more prepared high carbon instrument used in the Forties; since it will stand up to higher temperatures while not losing its hardness. This component licenses HSS to hack quicker than carbon-rich steel, in this way the name hot-works steel. At temperature, HSS audits generally have a high hardness (above HRC60) and scratched spot assurance (frequently related to W and metallic segment content ordinarily used in HSS) diverged from normal carbon and apparatus steel.

1.2.1 Properties of High Speed Steel

- High working hardness.
- High wear protection.
- Excellent durability.
- Compressive quality.
- High maintenance of hardness and red hardness.
- Strength to counteract breakage on the bleeding edge. The impact of alloying components on steel properties.

1.2.2 Structure of HSS

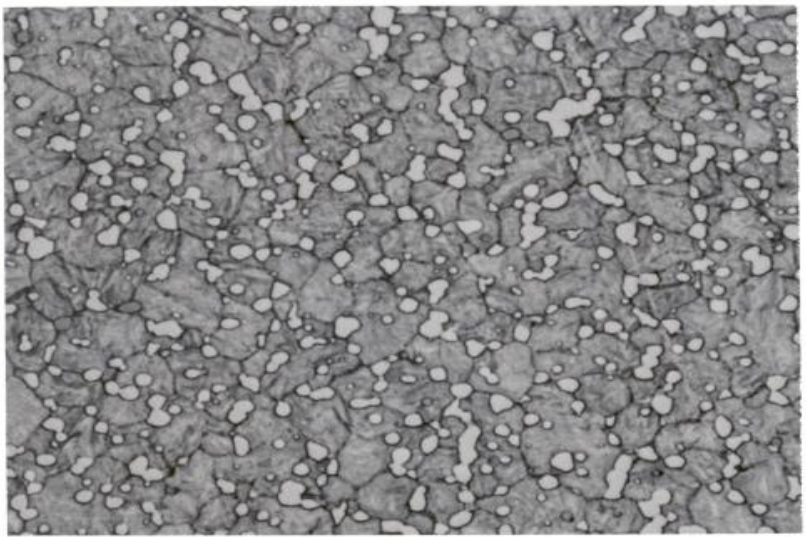


Fig. 1.2: Structure of HSS

Received: 19 Feb 2019 | Revised: 07 Mar 2019 | Accepted: 02 Apr 2019

1.2.3 Application

The principle utilization of HSS is as yet the generation of different cutting instruments: drills, taps, cutters, apparatus forceps, adapt cutters, saw edges, planers and blades, blades, and so on., in spite of the fact that they are utilized for stamping and punching increments.HSS has also found an excellent market for hand tools. They have high toughness and high wear resistance. They are reasonable for low-speed applications requiring tough, sharp edges, for example, grates, etches, hand-held blades and brilliant kitchen pockets. Blade and sword. High-speed steel cutters are the most popular in turning because the speed of the workpiece behind the cutting edges of the hand tools is relatively high, and the HSS blades are much longer than the high-carbon steel blades.

Advantage

The essential preferred standpoint of alleged rapid steels is in their capacity to withstand warm made from the contact of quick moving cutting apparatuses, for example, boring tools or saw sharp edges. They are defined with particular compounds which influence them to warm safe and safer than normal high carbon steels.

1.3 Chromium Nitrate – High Speed Steel

One layer of chromium nitride is compared to a double layer of paint (CrN / Cr / steel) where the middle layer of chromium is prepared by electroplating to improve corrosion properties and tribal properties of steel. CRN coatings were deposited using the industrial-grade cathode-ray deposition technique while the middle layer of chromium is prepared by electroplating. Coating arrangements were compared in terms of hardness, wear and corrosion resistance

II. COATINGS

2.1 Thin Films

The utilization of a thin film to any surface is a thin film proclamation. This surface may be a substrate or any previously put away layer. Most thin-film deposition techniques have a limiting thickness of several tens of nanometers.

Molecular Beam Epitaxy can be used to deposit a single atomic layer at any given time. The material to be stored is set in an entropic domain with the goal that the particles of material getting away from the surface. A cooler surface faces this material, which deprives the particles of energy upon arrival, forming a solid layer. The entire system is stored in a vacuum storage room to allow free transport of the particles. Since the particles tend to follow a straight path, films deposited by physical means are usually more directional than conforming.

2.1.1 Techniques for Thin-Film Deposition

Many techniques of thin-film deposition have been developed and further evolved to a greater level of sophistication for the purpose of product fabrication.

The methods and techniques used today can be classified broadly on the nature of deposition required such as chemical or physical nature. The flow chart that follows briefly outlines the various thin-film deposition techniques that are used:

Received: 19 Feb 2019 | Revised: 07 Mar 2019 | Accepted: 02 Apr 2019

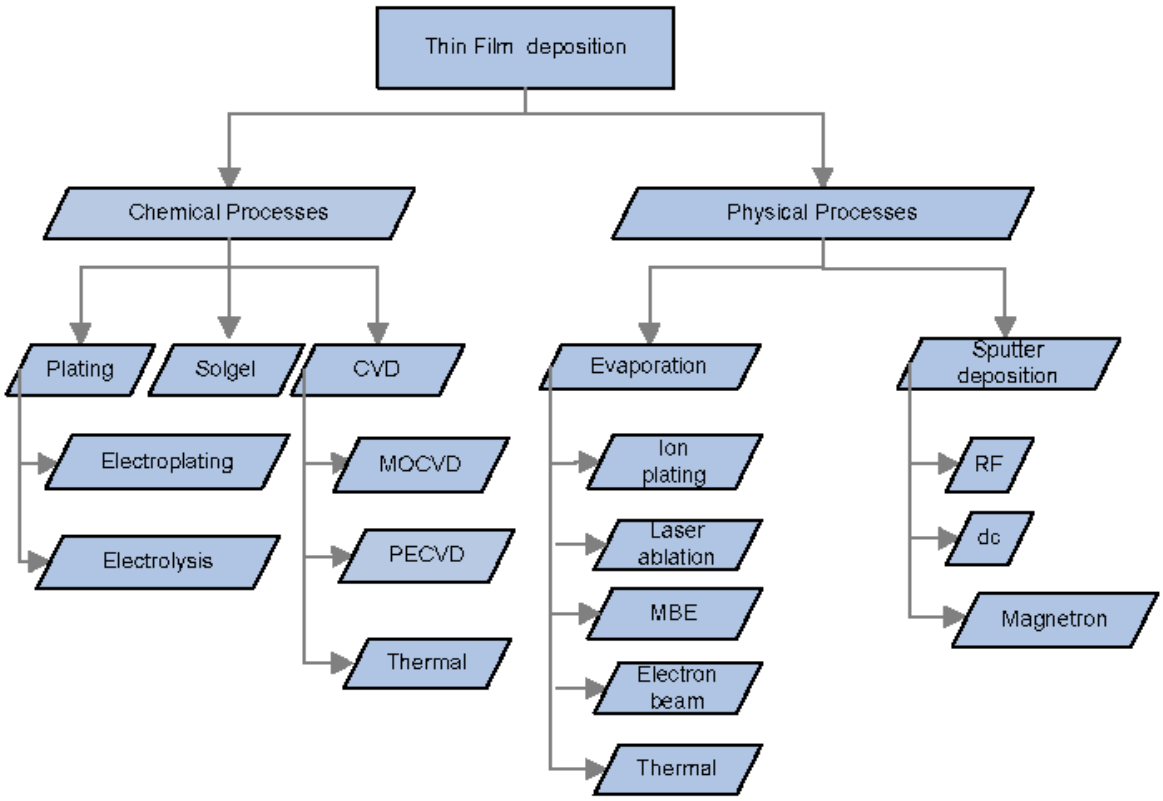


Fig. 2.1: Techniques for Thin-Film Deposition

2.2 Sol Gel

The sol-gel process is an engineered methodology for the production of materials, for instance, a metal oxide, starting with a compound game plan containing precursors (sol). These pioneers might be metal alkoxides and metal chlorides, which upon hydrolysis and polycondensation responses shape a colloid. The predecessor propels towards the game plan of an inorganic framework containing a liquid stage (gel) with or without warming. An arrangement of a metal oxide consolidates interfacing the metal fixations with 0x0 (M-O_M) or hydroxo (M-OH-M) ranges. as needs are making metal-0x0 or metal-hydroxo polymers in the course of action. The drying methodology removes the liquid stage from the gel, fundamentally molding a porous material. Treating is ordinarily done remembering the true objective to help encourage polycondensation and update mechanical properties. The sol may either be spared cash on a substrate to shape a film(e.g. by plunge covering or turn covering), cast into an appropriate compartment with the pined for shape(6.3. To get solid earthenware production, glasses, strands, layers, aerogels, and so on.) Or used to join powders(e.g. microspheres, Nanospheres).The sol-gel approach is conspicuous in light of the fact that it is a trashy framework which can be performed by cutting down temperatures. It considers the fine control on the mixture formation of the thing, even little measures of doping materials, for instance, characteristic hues and extraordinary earth metals can be displayed in the so and twist up finely scattered in the last thing. It can be used as a piece of pottery generation manufacturing shapes as a wander giving material or a piece of methods for making flimsy MMS of metal oxides for different purposes.

Received: 19 Feb 2019 | Revised: 07 Mar 2019 | Accepted: 02 Apr 2019

Applications of Sol Gel

The applications for sol gel-determined items are various. One of the biggest application territories is thin movies, which can be delivered on a bit of substrate by turn covering or plunge covering. Different strategies incorporate splashing, electrophoresis, inkjet printing or move covering. Optical coatings, defensive and improving coatings, and electro-optic segments can be connected to glass, metal and different sorts of substrates with these strategies.

Cast into a slope, and with moreover drying and warm treatment, thick let go or glass articles with novel properties can be molded that can't be made by some other methodology. Plainly visible optical components and dynamic optical segments and additionally extensive region hot mirrors, frosty mirrors, focal points and bar splitters all with ideal geometry can be made rapidly and be requiring little to no effort by means of the sol-gel course. With the thickness of a sol balanced into an appropriate range, both optical and obstinate earthenware strands can be drawn which are utilized for fiber optic sensors and powders of single-and multicomponent pieces can be made in submicrometer molecule measure for dental and biomedical applications. Composite powders have been licensed for use as agr chemicals and herbicides. Likewise, powder abrasives, utilized as a part of an assortment of completing tasks, are influenced utilizing a sol-to-gel write process. One of the more imperative utilizations of sol-gel preparing is to complete zeolite blend. Different components (metals, metal oxides) can be effectively fused into the last item and the silicate sol shaped by this strategy is extremely steady.

2.3 Dip Coating

The sol-gel technique may be performed either by spin coating or dip coating methods. Plunge covering is a mechanical covering process utilized as a part of the produce of a variety of products the procedure involves simple dipping of the object to be coated, into a gel bath. The process of dipping and slow removal of the substrate is usually repeated several times to allow a series of relatively thin films to be coated onto the substrate. Immersion dressings are often used for research purposes to spread the film on the substrate. The process of contamination stratification can be divided into five stages: Diving: The matrix is absorbed at a constant rate in the solution of the substance.

The yield is done at a consistent speed to keep any motions. Speed decides the thickness of the layer. The quicker the extraction, the thicker the layer. Seepage - the Excess liquid will deplete from the surface. Dissipation of the dissolvable vanishes from the fluid, which shapes a thin layer. For unstable fluids, for example, liquor, vanishing started amid the precipitation and waste stage..

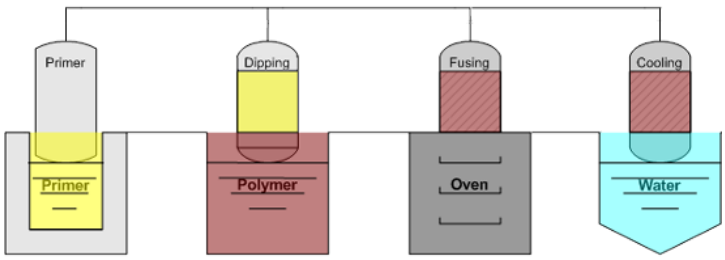


Fig. 2.2: Dip Coating Process

Received: 19 Feb 2019 | Revised: 07 Mar 2019 | Accepted: 02 Apr 2019

2.4 Spin Coating

A popular alternative to dip coating is spin coating technique for sol gel method. It is the method used to store uniform thin movies onto level substrates. For the most part, a little measure of covering material is associated with the point of convergence of the substrate which is either turning at low speed or not turning by any methods. The substrate is then spun at high speeds to spread the covering material by outward power. A machine used for turn covering is known as a turn coater or just spinner. The turn has continued while the fluid contorts off the edges of the substrate until the point that the pined for a thickness of the film is refined. The associated dissolvable is typically eccentric and in the meantime evaporates. The higher the speed, the thinner the film. The thickness of the film in like manner depends upon the consistency and merging of the course of action and the dissolvable. Turn covering is a particularly helpful procedure since it empowers us to make thin movies of nanoscale temperature. Four particular stages can be distinguished in the turn covering process:

1. Statement of the covering liquid onto the wafer or substrate (Perhaps done by utilizing a spout and pouring the covering, arrangement or by showering it onto the surface).
2. The substrate is quickened up to its last, wanted, turn speed.
3. The substrate is turning at a steady rate and liquid thick powers rule the liquid diminishing conduct.
4. The substrate is turning at a steady rate and dissolvable dissipation rules the covering diminishing
5. Conduct

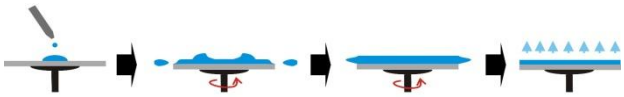


Fig. 2.3: Spin Coating Process

2.5 Ion Plating

Ion plating is generic term applied to film deposition process in which the substrate surface and the growing film or subjected to continuous or periodic flux of energetic massive bombarding particle (ions, radicals, atoms, molecules reactive or inert) sufficient to cause the angle in the film formation process and the properties of the deposited film. Equipment used for ion plating is similar to conventional vacuum coating unit. The additional feature is high voltage (35 kV). DC source used for biasing the substrate negative with respect to vapour source. The vapor source is the positive electrode (anode) and substrate is the negative electrode (cathode). It is then back field with inert gas, usually argon to a pressure of approximately 1_0.1 Pa. The gas pressure is kept constant through a suitable leak valve. Application of high voltage results in glow discharge and substrate gets cleaned by ion bombardment after cleaning the materials evaporated while the glow discharge is maintained underthese conditions deposition occurs not only on the face of the substrate facing the source but also and reverse side.

The process described above is sometimes referred to as diode ion plating.

Received: 19 Feb 2019 | Revised: 07 Mar 2019 | Accepted: 02 Apr 2019

III. LITERATURE REVIEW

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.

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, F.A SUAREZ-BUSTAMANTE, J.J OLAYA-FLOREZ) 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 in 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 - Comparative depiction of alumina coatings kept by RF,DC and beat open magnetron sputtering (R. Cremer a,*, M. Witthaut a, D. Neuschu¨ tz a, G.Erkens b,T. Leyendecker b)The hardness of sputtering condition upon the valuable stone structure of the films has been inspected by x-pillar diffraction, 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 using X-beam diffraction (XRD) and nanoindentation systems, exclusively. The holding structure of the coatings was depicted by X-beam photoelectron spectroscopy (XPS). The surface morphology of the coatings was considered using checking electron microscopy (SEM) and atomic power microscopy (AFM). The XRD data showed that the CrN and CrAlN coatings showed B1 NaCl structure.) 2193– 2201 - A close examination of responsive direct current magnetron sputtered CrAlN and Applied Surface Science 253 (2007) 5076– 5083 - Nanolayered multilayer coatings of CrN/CrAlN orchestrated by open DC magnetron sputtering (Harish C. Barshilia a,*, B. Deepthi a, N. Selvakumar an, Anjana Jain b, K.S. Rajam) Single-organize CrN and CrAlN coatings were put away on silicon and smooth steel substrates using a responsive

DC magnetron sputtering system. The helper depiction of the coatings was done using X -beam diffraction (XRD). The XRD data exhibited that the multilayer coatings were consistent up to a temperature of 650℃ and apexes identifying with Cr2O3 started appearing at 700℃. These results were confirmed.

Thin Solid Films 517 (2009) 1887– 1894 - A near investigation of CrNx coatings Synthesized by dc and beat dc magnetron sputtering (J. Lin, Z.L. Wu, X.H. Zhang, B. Mishra a, J.J. Moore, W.D. Sproul) Chromium nitride (CrNx) coatings were set up by responsively sputtering chromium metal focus with different nitrogen stream rate rates (fN2) utilizing a shut field unequal magnetron sputtering framework worked in dc and center recurrence beat condition.

IV. EXPERIMENTAL DETAILS

4.1 Ultrasonic Cleaning

Glass substrates are used in the experiment. These substrates are first washed thoroughly with detergent and water. They are the dried and placed in a beaker containing Chromic acid for 24 hours. The substrates are carefully removed and put in an ultrasonic cleaner for 15 minutes. They are then washed with detergent and water, further cleaned with acetone and finally allowed to dry.

4.2 Grinding and Polishing

Grinding removes the marks and levels of the saw and cleans the surface of the sample. Although it eliminates grinding artifacts, with little or no action. The grind uses mounted abrasives: the abrasive particles are guaranteed for the paper or the iron, for the rapid elimination of the stocks. Despite using free abrasives in a cloth; that is to say, the abrasive particles are suspended in a superior material and can roll or slide through the fabric and specimen. A book modified by Marinescu et al. It describes well the scientific aspects of ceramic abrasion processes. Some companies do not distinguish between grinding and spraying, as in the previous paragraph, however, they use the overlapping term to mean molding or thick structure with the abrasive grade suspension associated with a resistant metal plate. The production of ceramics and the production of ceramics to provide an extraordinary surface. The ceramic samples will be molded and polished manually, however, automatic machines usually produce more efficient and faster duplicable results. Manual grinding allows for a greater management of the grinding depth than automatic grinding, which may well be vital once the cross section at a selected depth is of interest. Automatic instrumentation is more expensive than manual machines. Diamond abrasives are advised to grind most ceramics, but the carbide paper (SiC) and cubic atomic nitrous number 5 (CBN) platforms can also be used. Finish each abrasive step when the artifacts (for example, cracks or scratches) imparted by the previous step are completely eliminated. The sizes of abrasives and sizes of metric linear units are correlated in Appendix C.

4.3 Sputtering Process

Before you enter a clean room, be sure to turn on the spray network in the service area. Turn on the chiller, open the water supply valve and check the water circulation. Power supply and water supply of the system is carried out from the service area outside the clean room. Before starting DP, the status of each valve must be confirmed as follows: Main valve-CLOSE.

Received: 19 Feb 2019 | Revised: 07 Mar 2019 | Accepted: 02 Apr 2019

Fig. 4.1: RF/DC Magnetron Sputtering

2. Drying valve - CLOSE, 3.Foreline (back) -Clock valve, 4. Drainage valve – Close Start of pump pump diffusion system (DP): Before entering the room, you must activate dust in the service area. Turn off the cold water valve and check the flow of water. Electricity and water supply in the system are downloaded from the service area outside of the clean room.

Chamber Ventilation Valve

Activate the main power switch and the rotary pump (RP). After reducing the RP noise, open the front cover and activate the diffusion pump (DP) section. After about 20 minutes, DP will start. During this time of 20 minutes, the following sample loading procedure can be performed.

Create a Vacuum

OPEN the ratchet valve and wait until the Pirani meter pressure shows 0.05 mbar (about 15 minutes). Close the valve and open the front cover. Pour liquid nitrogen through LN2 trap. Open the main valve. Activate the Pirani indicator and wait until the room pressure reaches 2X10-5 mbar. Note: This evacuation requires approximately

Adjusting the Pressure of the Deposit

Once the vacuum reaches 2X10-5 milli bar Place the Argon (Ar) gas into the room by gradually opening the argon inlet valve. Be careful not to exceed the 2X10-2 mbar pressure to protect the DP's operation. Gradually close the main valve to align the storage pressure. Confirm if the pressure is stable.

Note: The deposit rate of each material depends on the pressure of the deposit. To get reproducible results, use the same values.

Rinse argon for 5 minutes; that is, leave it under the specified pressure deposition conditions (it is made to crush the air molecules if there is any after the evacuation)

Sputtering: Before starting to fall, select the appropriate cathode (since the system has 3 lenses), using the cathodic selection key. The same applies to the cathode plug. Set the RF / DC selection button to RF. Activate the

Received: 19 Feb 2019 | Revised: 07 Mar 2019 | Accepted: 02 Apr 2019

RF power supply; Apply the voltage on the cathode. Set the maximum voltage of the anode current with the corresponding control box button. After the luminescent discharge occurs, the game returns to the maximum as the RF Energy Control Controller and the power to a minimum.

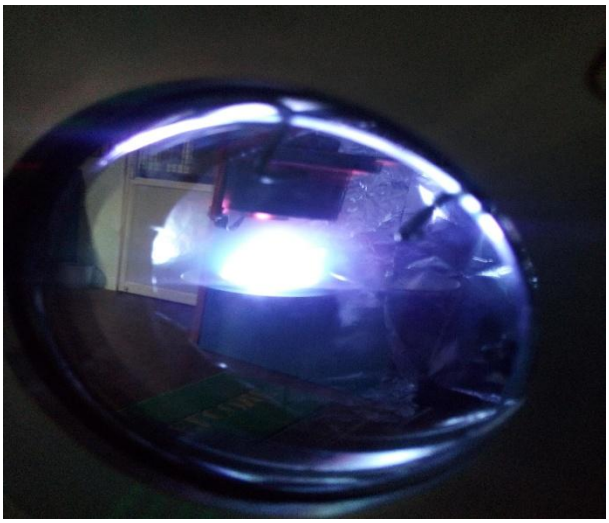


Fig. 4.2 (a): RF Sputtering Process

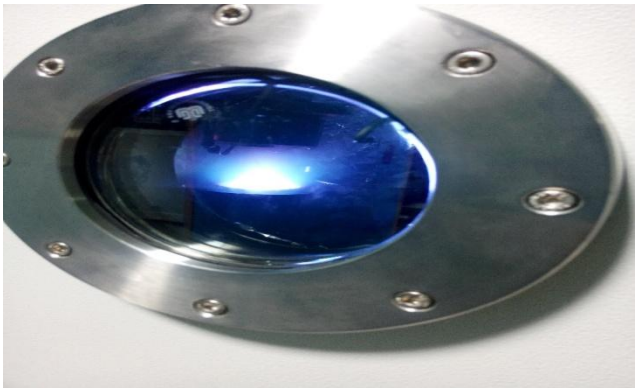


Fig. 4.2(b): RF Sputtering Process

Taking out the Substrate

Once the main sputtering is complete, reduce the voltage and switch off the RF power supply. Close main valve and AR gas inlet. Wait for the ventilator valve of the open room to release the camera's vacuum. As soon as the camera reaches atmospheric pressure, open the room and remove the substrate. Close the camera and close the camera. It takes about 10 minutes to get the substrate temperature low. After 10 min CLOSE the system's brake and shut-off valve

Open the opening valve to evacuate the camera and keep it under vacuum for 10 minutes. (this is to avoid the accumulation of humidity in the room). SLAAP threshold valve. Turn off the DP switch. Line valve open for 20 min. After 20 minutes CLOSE before departure valve and OFF OFF rotary pump switch. NA main switch. Disconnect the Chiller and network in the service.

Received: 19 Feb 2019 | Revised: 07 Mar 2019 | Accepted: 02 Apr 2019

V. RESEARCH METHODOLOGY

5.1 Atomic Force Microscopy

The Atomic Force Microscope (AFM) is a sort of examining test magnifying instrument (SPM). SPMs are intended to measure adjacent properties, for example, length, disintegration, engaging quality with a test. To ensure a picture, the SPM lattice looks at the test in a little zone of the illustration and continually evaluates the property adjacent. AFMs work by estimating the performance of a test and the example. Typically, the test is a sharp point, containing a 3-6 μm. m long pyramid with 15-40 nm indeed is. Despite the fact that the horizontal determination of AFM due to folding is small (~ 30 nm), the vertical determination may be dependent on 0.1 nm. In order to obtain the image determination, AFMs can usually measure the vertical and lateral deviations on the cantilever with the optical lever. The optical lever works by mirroring a tilted laser pointer. The reflector laser beam hits a photographer with a position that consists of four sections tipper. Piezo-ceramic production is the point of high determination. Piezoelectric ceramic is a class of material that protrudes or contracts when in a voltage trap.

5.2 Raman Spectroscopy

Raman spectroscopy utilizes the Raman impact of substance examination. The range of Raman scattered light relies upon the atomic parts introduce and their state with the goal that the range can be utilized for material ID and investigation. Raman spectroscopy is utilized to investigate an assortment of materials, including gases, fluids, and solids. Exceedingly intricate materials, for example, natural life forms and human tissue can likewise be broken down by Raman spectroscopy. For solids, Raman diffusing is utilized as a device to recognize high-recurrence phonon and magnon cancellation. Raman component is utilized as a part of barometrical material science to back off the climatic annihilation coefficient and the impediment of water vapour.

5.3 Chemical Analysis

In wet chemistry, glassware such as cups and graduated cylinders are commonly used to prevent contamination or disruption of materials by unintentional sources. Gasoline, Bunsen burners and crossbreeds can also be used to vaporize and isolate substances in their dry forms. Wet chemistry is not performed on advanced instruments as most automatic scans are scanned.

5.4 Salt Spray Test

This quickened research center test was designed toward the start of the twentieth century. It gives a controlled destructive condition and is utilized to give relative protection from erosion protection for tests of metals and covered metals uncovered in a test room. The exemplary ASTM B117 salt splash test is to deform a salt solution into uniform droplets on samples stored or suspended between 15 and 30 ° C. The saline solution is a solution of 5% by weight of NaCl (more than seawater) only 1.8% to a maximum of 3%). The presentation zone of the salt shower chamber is kept up at 35 ° C. The pH of the saline arrangement is with the end goal that the immersed arrangement, when expanded to 35 ° C, is in a pH scope of 6.5 to 7.2.The test is continuous for the duration of the entire trial period. The exposure period is agreed between the buyer and the seller. It can reach more than 1000H. There are other accelerated testing methods - in aging tests, which are often used in the automotive industry. These tests are briefly described below. The main corrosive element is moisture, which is used in all aging tests, supplemented by

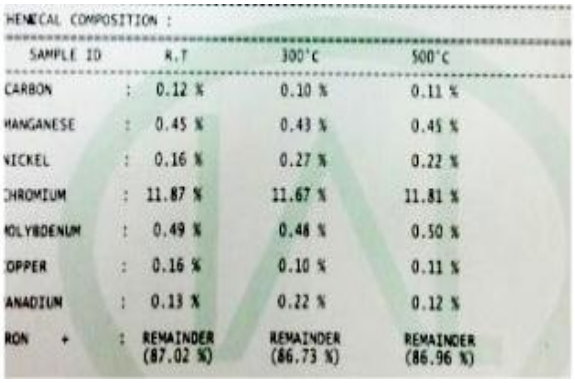
Received: 19 Feb 2019 | Revised: 07 Mar 2019 | Accepted: 02 Apr 2019

salt fog and / or temperature-change.

VI. Result And Discussions

6.1 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 6.1). 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. 6.1: Wet Chemical Analysis for RT, 300 °C, 500°C

6.2 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, it can be inferred that the corrosion resistance of High speed steel (M2) has been increased RT, 300°C,500°C.

6.3 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

6.4 Composition and Structure of CrN /HSS Film

6.4.1 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

Received: 19 Feb 2019 | Revised: 07 Mar 2019 | Accepted: 02 Apr 2019

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.

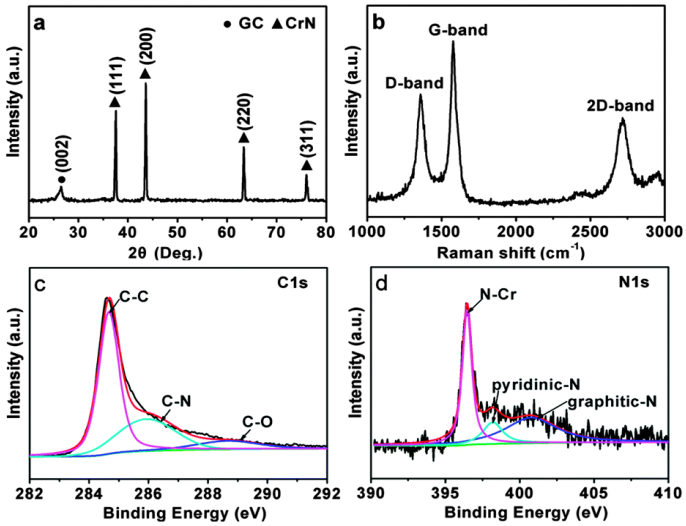
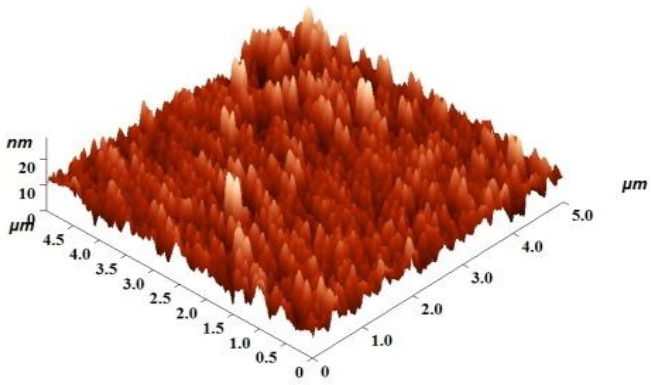


Fig. 6.4.1: Raman Microstructure Analysis

6.4.2 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.6.4.2 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.



Received: 19 Feb 2019 | Revised: 07 Mar 2019 | Accepted: 02 Apr 2019

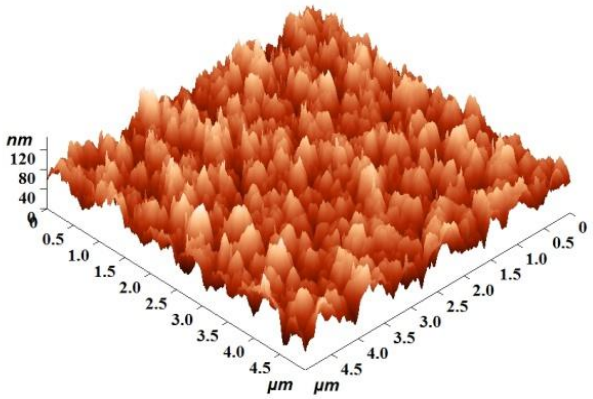


Fig. 6.4.2 (a) 5μm × 5μm 3D Image of Coated Sample at Room Temperature

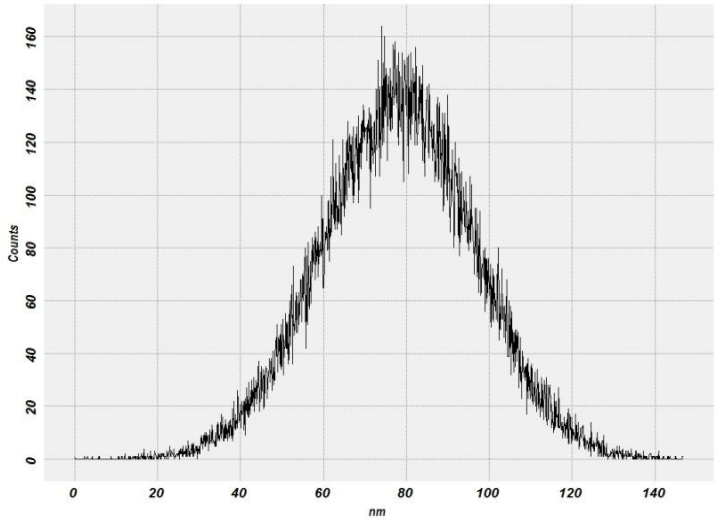


Fig 6.4.2 (b) 5μm × 5μm 3D Image of Coated Sample at 300°C Temperature & Histogram Analysis

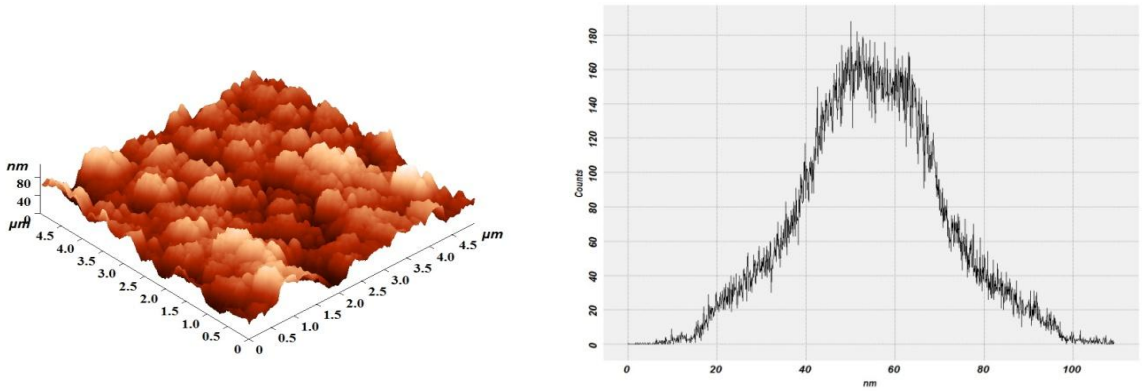


Fig 6.4.2 (c) 5μm × 5μm 3D Image of Coated Sample at 500°C Temperature & Histogram Analysis

6.4.3 Micro Structure

The surface that has been etched with picric acid showed selective corrosion at the prior γ grain boundaries are observed Metallurgical microscope METSCOPE-1A. The nominal grain size that was determined from microscopic images in the view of 100 micro meters by the cutting method (refer Fig 6.4.3 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.

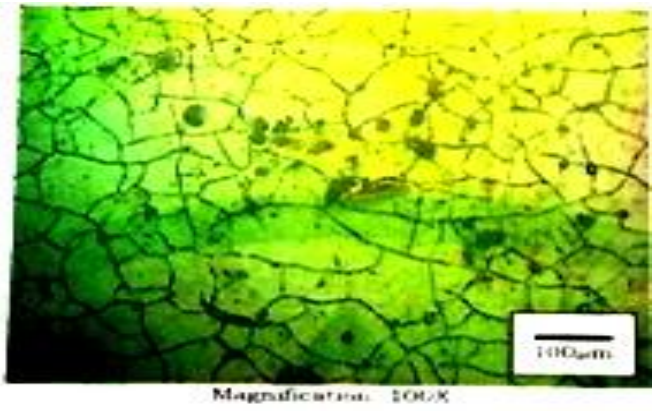


Fig. 6.4.3 (a)

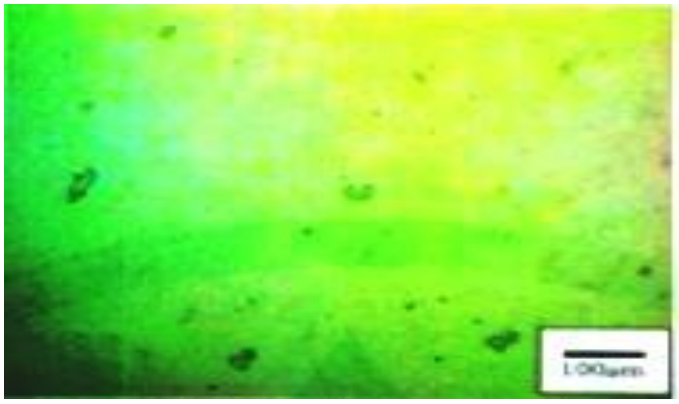


Fig. 6.4.3 (b)

Fig. 6.4.3 (c)

Fig. 6.4.3: Microstucture analysis of (a) RT (b) 300°C (c) 500° C

Received: 19 Feb 2019 | Revised: 07 Mar 2019 | Accepted: 02 Apr 2019

VII. CONCLUSION

The impact of oxygen halfway weight and substrate temperature on the structure and hardness of chrome films and also the testimony rate is examined for 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 rate and the substrate temperature from one viewpoint and the testimony rate as the 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 microwave sputtering procedure appears to offer a reasonable bargain between film quality and sparing 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. It has been discovered that CrN coatings withstand somewhat more assault from the Cl-containing operators than the CrN coatings. Coatings with a low gap or pore thickness are because of higher outcomes. To stay away from this impact in an extremely conservative strategy additionally ponders on multilayer coatings can be completed.

REFERENCES

[1] Thooyamani, K.P., Khanaa, V., & Udayakumar, R. (2014). Virtual instrumentation based process of agriculture by automation. *Middle-East Journal of Scientific Research*, *20*(12): 2604-2612.

[2] Udayakumar, R., Kaliyamurthie, K.P., & Khanaa, T.K. (2014). Data mining a boon: Predictive system for university topper women in academia. *World Applied Sciences Journal*, *29*(14): 86-90.

[3] Anbuselvi, S., Rebecca, L.J., Kumar, M.S., & Senthilvelan, T. (2012). GC-MS study of phytochemicals in black gram using two different organic manures. *J Chem Pharm Res*., *4*, 1246-1250.

[4] Subramanian, A.P., Jaganathan, S.K., Manikandan, A., Pandiaraj, K.N., Gomathi, N., & Supriyanto, E. (2016). Recent trends in nano-based drug delivery systems for efficient delivery of phytochemicals in chemotherapy. *RSC Advances*, *6*(54), 48294-48314.

[5] Thooyamani, K.P., Khanaa, V., & Udayakumar, R. (2014). Partial encryption and partial inference control based disclosure in effective cost cloud. *Middle-East Journal of Scientific Research*, 20(12), 2456-2459.

[6] Lingeswaran, K., Prasad Karamcheti, S.S., Gopikrishnan, M., & Ramu, G. (2014). Preparation and characterization of chemical bath deposited cds thin film for solar cell. *Middle-East Journal of Scientific Research*, *20*(7), 812-814.

Received: 19 Feb 2019 | Revised: 07 Mar 2019 | Accepted: 02 Apr 2019

[7] Maruthamani, D., Vadivel, S., Kumaravel, M., Saravanakumar, B., Paul, B., Dhar, S.S., Manikandan, A., & Ramadoss, G. (2017). Fine cutting edge shaped Bi2O3rods/reduced graphene oxide (RGO) composite for supercapacitor and visible-light photocatalytic applications. *Journal of colloid and interface science*, *498*, 449-459.

[8] Gopalakrishnan, K., Sundeep Aanand, J., & Udayakumar, R. (2014). Electrical properties of doped azopolyester. *Middle-East Journal of Scientific Research*, *20*(11). 1402-1412.

[9] Subhashree, A.R., Parameaswari, P.J., Shanthi, B., Revathy, C., & Parijatham, B.O. (2012). The reference intervals for the haematological parameters in healthy adult population of chennai, southern India. *Journal of Clinical and Diagnostic Research: JCDR*, *6*(10), 1675-1680.

[10] Niranjan, U., Subramanyam, R.B.V., & Khanaa, V. (2010, September). Developing a web recommendation system based on closed sequential patterns. In *International Conference on Advances in Information and Communication Technologies*, *101*, 171-179. Springer, Berlin, Heidelberg.

[11] Slimani, Y., Baykal, A., & Manikandan, A. (2018). Effect of Cr3+ substitution on AC susceptibility of Ba hexaferrite nanoparticles. *Journal of Magnetism and Magnetic Materials*, *458*, 204-212.

[12] Premkumar, S., Ramu, G., Gunasekaran, S., & Baskar, D. (2014). Solar industrial process heating associated with thermal energy storage for feed water heating. *Middle East Journal of Scientific Research*, *20*(11), 1686-1688.

[13] Kumar, S.S., Karrunakaran, C.M., Rao, M.R.K., & Balasubramanian, M.P. (2011). Inhibitory effects of Indigofera aspalathoides on 20-methylcholanthrene-induced chemical carcinogenesis in rats. *Journal of carcinogenesis*, *10*.

[14] Beula Devamalar, P.M., Thulasi Bai, V., & Srivatsa, S.K. (2009). Design and architecture of real time web-centric tele health diabetes diagnosis expert system. *International Journal of Medical Engineering and Informatics*, *1*(3), 307-317.

[15] Ravichandran, A.T., Srinivas, J., Karthick, R., Manikandan, A., & Baykal, A. (2018). Facile combustion synthesis, structural, morphological, optical and antibacterial studies of Bi1− xAlxFeO3 ($0.0 \leq x \leq 0.15$) nanoparticles. *Ceramics International*, *44*(11), 13247-13252.

[16] Thovhogi, N., Park, E., Manikandan, E., Maaza, M., & Gurib-Fakim, A. (2016). Physical properties of CdO nanoparticles synthesized by green chemistry via Hibiscus Sabdariffa flower extract. *Journal of Alloys and Compounds*, *655*, 314-320.

[17] Thooyamani, K.P., Khanaa, V., & Udayakumar, R. (2014). Wide area wireless networks-IETF. *Middle-East Journal of Scientific Research*, *20*(12), 2042-2046.

[18] Sundar Raj, M., Saravanan, T., & Srinivasan, V. (2014). Design of silicon-carbide based cascaded multilevel inverter. *Middle-East Journal of Scientific Research*, *20*(12), 1785- 1791.

[19] Achudhan, M., Jayakumar M.P. (2014). Mathematical modeling and control of an electrically-heated catalyst. *International Journal of Applied Engineering Research*, *9*(23), 23013.

[20] Thooyamani, K.P., Khanaa, V., & Udayakumar, R. (2013). Application of pattern recognition for farsi license plate recognition. *Middle-East Journal of Scientific Research*, *18*(12), 1768-1774.

[21] Jebaraj, S., Iniyan S. (2006). Renewable energy programmes in India. *International Journal of Global Energy Issues*, *26*(43528), 232-257.

[22] Sharmila, S., & Jeyanthi Rebecca, L. (2013). Md Saduzzaman., Biodegradation of domestic effluent using different solvent extracts of Murraya koenigii. *J Chem and Pharm Res*, *5*(2), 279-282.

[23] Asiri, S., Sertkol, M., Guner, S., Gungunes, H., Batoo, K.M., Saleh, T.A., Manikandan A., & Baykal, A. (2018). Hydrothermal synthesis of CoyZnyMn1-2yFe2O4 nanoferrites: magneto-optical investigation. *Ceramics International*, *44*(5), 5751-5759.

[24] Rani, A.J., & Mythili, S.V. (2014). Study on total antioxidant status in relation to oxidative stress in type 2 diabetes mellitus. *Journal of clinical and diagnostic research: JCDR*, *8*(3), 108-110.

[25] Karthik, B. (2014). Arulselvi, Noise removal using mixtures of projected gaussian scale mixtures. *Middle-East Journal of Scientific Research*, *20*(12), 2335-2340.

[26] Karthik, B., Arulselvi, & Selvaraj, A. (2014). Test data compression architecture for low power VLSI testing. *Middle - East Journal of Scientific Research*, *20*(12), 2331-2334.

[27] Vijayaragavan, S.P., Karthik, B., & Kiran Kumar, T.V.U. (2014). Privacy conscious screening framework for frequently moving objects. *Middle-East Journal of Scientific Research*, *20*(8), 1000-1005.

[28] Kaliyamurthie, K.P., Parameswari, D., & Udayakumar, R. (2013). QOS aware privacy preserving location monitoring in wireless sensor network. *Indian Journal of Science and Technology*, *6*(5), 4648-4652.

[29] Silambarasu, A., Manikandan, A., & Balakrishnan, K. (2017). Room-temperature superparamagnetism and enhanced photocatalytic activity of magnetically reusable spinel ZnFe 2 O 4 nanocatalysts. *Journal of Superconductivity and Novel Magnetism*, *30*(9), 2631-2640.

[30] Jasmin, M., Vigneshwaran, T., & Beulah Hemalatha, S. (2015). Design of power aware on chip embedded memory based FSM encoding in FPGA. *International Journal of Applied Engineering Research*, *10*(2), 4487-4496.

[31] Philomina, S., & Karthik, B. (2014). Wi-Fi energy meter implementation using embedded linux in ARM 9. *Middle-East Journal of Scientific Research*, *20*, 2434-2438.

[32] Vijayaragavan, S.P., Karthik, B., & Kiran Kumar, T.V.U. (2014). A DFIG based wind generation system with unbalanced stator and grid condition. *Middle-East Journal of Scientific Research*, *20*(8), 913-917.

[33] Rajakumari, S.B., & Nalini, C. (2014). An efficient data mining dataset preparation using aggregation in relational database. *Indian Journal of Science and Technology*, *7*, 44-46.

[34] Karthik, B., Kiran Kumar, T.V.U., Vijayaragavan, P., & Bharath Kumaran, E. (2013). Design of a digital PLL using 0.35 Î¼m CMOS technology. *Middle-East Journal of Scientific Research*, *18*(12), 1803-1806.

[35] Sudhakara, P., Jagadeesh, D., Wang, Y., Prasad, C.V., Devi, A.K., Balakrishnan, G., Kim B.S., & Song, J.I. (2013). Fabrication of Borassus fruit lignocellulose fiber/PP composites and comparison with jute, sisal and coir fibers. *Carbohydrate polymers*, *98*(1), 1002-1010.

[36] Kanniga, E., & Sundararajan, M. (2011). Modelling and characterization of DCO using pass transistors. In *Future Intelligent Information Systems*, 86(1), 451-457. Springer, Berlin, Heidelberg.

[37] Sachithanandam, P., Meikandaan, T.P., & Srividya, T. Steel framed multi storey residential building analysis and design. *International Journal of Applied Engineering Research*, *9*(22), 5527-5529.

[38] Kaliyamurthie, K.P., Udayakumar, R., Parameswari, D., & Mugunthan, S.N. (2013). Highly secured online voting system over network. *Indian Journal of Science and Technology*, *6*(S6), 4831-4836.

[39] Sathyaseelan, B., Manikandan, E., Lakshmanan, V., Baskaran, I., Sivakumar, K., Ladchumananandasivam, R., Kennedy, J., & Maaza, M. (2016). Structural, optical and morphological properties of post-growth calcined TiO2 nanopowder for opto-electronic device application: Ex-situ studies. *Journal of Alloys and Compounds*, *671*, 486-492.

[40] Saravanan, T., Sundar Raj M., & Gopalakrishnan K. (2014). SMES technology, SMES and facts system, applications, advantages and technical limitations. *Middle - East Journal of Scientific Research*, *20*(11), 1353-1358.

[41] Elijah, Aiden, (2018). Co-Clustering based Cross-Domain Text Classification Algorithm with Semantic ANALYSIS for Wikipedia.*Journal of Computational Information Systems, 14*(3), 44 - 49.

[42] Asim, M., Gopalia, R., & Swar, S.(2014). Comparison of Methods for Solving Travelling Salesmen Problem.*International Journal of Advances in Engineering and Emerging Technology*, *5*(2), 80-87.

[43] Kowsalya, P., & Rajhitha, G. (2015). Design and Implementation of AMI System for High Traffic Smart Grid Applications using ZigBee. *Excel International Journal of Technology, Engineering and Management, 2*(1), 14-18.

[44] Skaria, B., Dr. John, E.T., & Shajan, P.X. (2016). Literature Review on Web Mining. *Bonfring International Journal of Data Mining*, *6*(1), 04-06.

[45] Moravej, Z., Behravesh, V., & Bagheri, S. (2015). Optimal PMU Placement for Power System Using Binary Cuckoo Search Algorithm. *International Academic Journal of Innovative Research, 2*(10), 8-19.

[46] Retheesh, D. (2014). Analysis on FPGA Designs of Parallel High Performance Multipliers. *International Journal of Communication and Computer Technologies, 2*(1), 11-18.

[47] Khan, A., & Dr. Khushnood, S. (2017). Simple and Efficient Blood Glucose Measurement Technique Using Non Invasive Artificial Intelligence. *Bonfring International Journal of Industrial Engineering and Management Science, 7*(1), 09-13.

[48] Omidvar, R. (2015). OOSP (Off-On Sources Problem). International Academic Journal of Science and *Engineering*, *2*(5), 22-31.

[49] Rajalakshmi, J., (2014). Implantable CPW Fed X-Shaped Monopole Antenna for Biomedical Application. *International Journal of System Design and Information Processing*, *2*(1), 23-26.

[50] Kaveen, P., & Dr.Singaravel, G. (2018). Simulation of Efficient Life-Time in Clustering Approaches for New Approach in Wireless Sensor Network. *Bonfring International Journal of Networking Technologies and Applications*, *5*(1), 1-2.