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A REVIEW ON BEHAVIOUR OF COMPOSITE COATINGS

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Abstract - The codeposition of micro particles inside an electroplating procedure is a proficient technique to create such improved materials. The particles are utilized to perform explicit mechanical, electrical, piezoelectric or attractive properties in slight coatings. The point of giving a covering to a substrate is to improve a portion of its properties of the substrate or to acquire a totally new property. The composite covering innovation is utilized many assembling regions. Composites are multifunctional materials having remarkable mechanical and physical properties that can be modified to meet the necessities of a specific application. Present day innovation goes for frameworks performing palatably under extraordinary working conditions .as of late, electroplating has risen as an actually and monetarily feasible union course to deliver nanostructured metals, amalgams and composite materials both in mass structure and as covering of different thicknesses. An electrodeposited composite covering comprises of a metal or compound network containing a scattering of second stage particles. These particles might be carbide particles or hard oxides, for example, SiC, TiO2, WC, SiO2 Al2O3 or precious stone, or even fluid containing microcapsules to create wear obstruction properties and/or to lessen rubbing. The point of this paper is to audit the writing important to the electrocodeposition of MMC coatings and its portrayal structure micro innovative applications.

Key words: Metal matrix, composite coatings, Material properties, Electrodeposition, Co-deposition, Micro technology

I. INTRODUCTION

Present day innovation calls for frameworks performing palatably under extraordinary working conditions. The composite covering technique is utilized widely in many assembling areas. Electrodeposited composite coatings are of intrigue essentially for wear or high warm applications and are superior to anything fire saved coatings. The improvement of metal network composites has pulled in a considerable measure of consideration in now a days on account of the prerequisites of high quality, lightweight and high firmness materials. The purpose behind utilizing coatings is ruled by financial or mechanical contemplations, that is, it is either less expensive to utilize a covering rather than mass material or the ideal properties can just accomplished by just covering. The uses of composite coatings are found in numerous regions in mechanical framework.

In this article, the writing identified with the electrodeposited composite coatings and its structure, properties of different electrodeposited coatings, uses of electrodeposited coatings has been surveyed. Division 2 depict the data about electrodeposited composite coatings. Division 3 surveys the total writing of articles resolved to be identified with electrodeposited composite coatings.

II. COMPOSITE COATINGS

Electrodeposited composite coatings consist of a metal matrix with either a ceramic or cermet particle addition which represents the new development in the field of coating processes. Electro-composite coating is a co-deposition of a homogeneously dispersed second phase material on the surface of the substance material with the form of a particulate material, whisker, and fibre in a metal matrix with enhanced or new engineering properties. Inert particles such as diamond, powdered ceramics (for example aluminum oxide, silicon nitride and silicon carbide) or polytetrafluoroethylene (PTFE or Teflon) can be deposited on the nickel matrix, forming a composite.

In general deposition of a metal occurs on a substrate surface by the reduction of metal ions in solution. If the reduction is brought out by electrical energy than the process is called Electroplating. In conventional electroplating, insoluble suspended impurity particles present in electrolyte has been entrapped / co deposited with the metal deposition on the substrate. This resulted in greater outcome on the end property of the deposition. In formation of electrodeposited composite coatings, the similar method of mechanical entrapment of suspended insoluble particles is used but under strictly controlled conditions. In formation of electrodeposited composite coating, the insoluble particles are dispersed in a

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conventional electroplating bath. The dispersed particles can be metallic or ceramic. During the electrolysis, the insoluble particles are trapped by the metal ion during its reduction from the cathode and a composite deposit is formed. The particles are held in suspension by mechanical agitation. Electroplating process which are readily amenable to composite electrodeposition are those which operate at high cathode efficiency. The main two factors governing the particle entry into the metal matrix are the presence of a gas stream and the particle size.

Various types of wear resistant electro-composite coating are,

- Ni-SiC Electro-Composite Coating
- Ni-diamond Electro-Composite Coating
- Ni – Al_2O_3Electro-Composite Coating etc.,

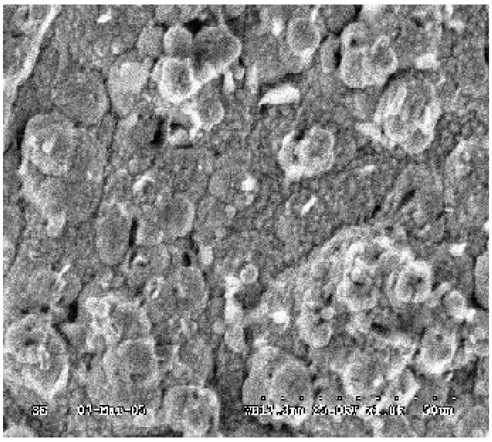

Fig.1 *SEM image of SiC Composite Coating*

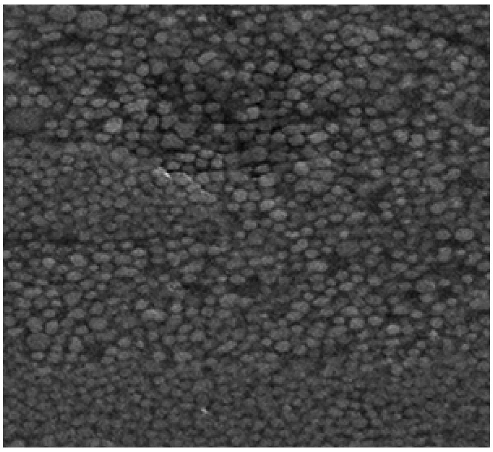

Fig.2 *SEM image of Zirconia Composite Coating*

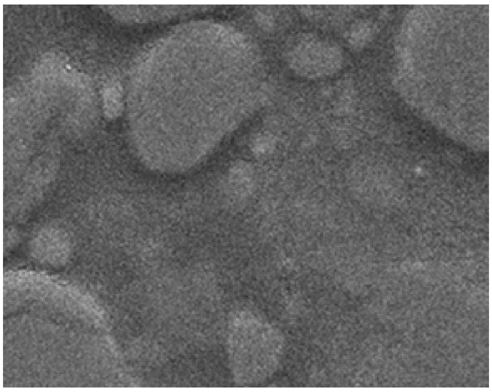

Fig.3 *SEM image ofAlumina Composite Coating*

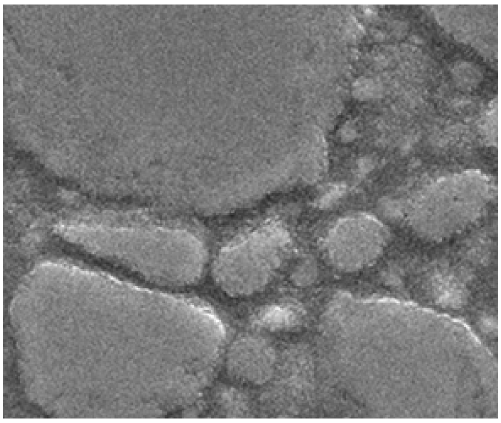

Fig.4 *SEM image of Titanium Oxide Composite Coating*

The use of ceramic particles in a metal matrix has long been used as a means of achieving tough, dispersion hardened coatings For example, a major impact of composite plated coatings has traditionally been in automotive engines for wear resistance and improved lubrication, where Ni-SiC and Ni-PTFE are both accepted coating options, e.g. in high performance internal combustion cylinder liners such as those used in prestige road cars or competitive automotive sports cars and motorcycles. A more specialist use has been in wear resistant tool facings, where competition exists from thin vacuum deposited layers, such as Co-WC and Ni-TiN ones. Surviliene and co-workers at Vilnius University have examined the effect of SiC on the corrosion behaviour of 10 mm thick chromium coatings electroplated from a hexavalent bath containing 10 g dm23 SiC, making extensive use of electrochemical impedance spectroscopy at the corrosion potential 0.1M H_2SO_4z Na_2SO_4, the composite coatings showed a much lower corrosion rate than a chromium plated layer, as evidenced by their increased charge transfer impedance (i.e., larger semicircles) especially in the case of hybrid Ni-WC-SiC composite coatings deposited from baths containing higher particle concentrations.

III. COATINGS

Coatings can be thought as the engineering solution to protect surface against wear, corrosion, degradation of the surface and other surface related phenomena. Acceptable coatings are generally characterized by good adhesion, substrate compatibility and low porosity. Coating must also be compatible with physical constraints of the substrate such as temperature and geometry. These coating/substrate attributes include matching the coefficient of thermal expansion, melting point of the substrate and chemical compatibility during the deposition and the service.

At times cracking of the protective film is followed by the breakdown in the protection of the substrate leading to the localized environmental network. For this reason, thermal expansion match between the coating and the substrate is important and the ductile coatings are able to avoid cracks that are necessary to avoid corrosion attacks.

Coatings are used in both aqueous and high temperature applications. Coal gasification, electric power generation and waste incineration involve severe environmental conditions and thick coatings have proved to be an effective solution. Diesel and gas turbine engines are subject to high temperature corrosion and highly beneficial coatings are required to combat the severe environmental effects. In addition to substrate compatibility, other factors like adhesion or porosity, the prospects of repair or recoating, inter-diffusion, effect of thermal cycling, resistance to wear and corrosion, and cost may also be needed to be taken into consideration. The functional or decorative coatings re normally designed as an integrated whole, taking into account all these considerations.

Different techniques have been employed for the preparation of the nanocomposite coatings including chemical vapour deposition (CVD), physical vapour deposition (PVD), electrodeposition, thermal spray, sol-gel methods and laser electron beam surface treatment. Processing parameters can be carefully controlled to obtain a fine grain size and required coating properties.

IV. LITERATURE SURVEY

Clint and Michael have reported that surface coatings have gained great reputation over the past several years and are prevalent in a more number of industries which include aerospace, automobile, computer, machining and precision manufacturing industries [1]. Hagedorn and Weinert mentioned that metal matrix composites (MMCs) are very commonly used to combine low structural weight with high wear resistances in the component development of automobiles. As a matrix work piece material as aluminium or magnesium is used because of their low density,reasonable mechanical strength and super hard fibers or particles made of silicium carbide ,aluminium oxide or titanium dibroide[2]. Kılıc kap et al has found that aluminium, titanium and magnesium alloy can be used as metal matrix element and the accepted reinforcements are silicon carbide (SiC) and alumina (Al_2O_3). Aluminium-based SiC particle reinforced MMC materials are used for many Engineering applications because of their properties such as less weight, heat-resistant, wear-resistant and low cost. Hui et al explained that a brush plated alloy Ni–Fe–W–S coating having a corrosion resistance is greater than that of electrodeposited chromium and a superior wear resistance than that of electrodeposited chromium at high speed and heavy load under normal conditions where lubricant was applied between the contact surfaces.

V. CONCLUSION

Surface Engineering is the modification of surfaces for a variety of reasons such as to enhance the corrosion resistance, decrease wear or to provide electrical or thermal insulation. Improvement in material properties is inevitable in order to meet the advanced engineering applications. Electrodeposition of composite coatings plays a remarkable role to obtain desired physical properties in the metal matrix composites. This article deals with some work of the earlier investigators on electrodeposited composite coatings has been reviewed, that can be used for characterization of coatings for micro technology applications. Details about these, and indeed about all the information's presented in this article, are available in the literature. It is nevertheless hoped that this article serves as a preliminary introduction for electrodeposited composite coatings.

Ni-SiC composite coatings

Ni-SiC composite coatings are widely used for the protection of friction parts due to their high wear resistance and low cost of ceramic powder. Zimmerman et al synthesized Ni-SiC composite coatings by pulse electrodeposition allowing high over potential and low surface diffusion rates resulting in formation of new nuclei [95]. The composite coatings exhibited four times hardness than annealed nickel and two times hardness than regular grain size nickel matrix. Vaezi et al evaluated wear and corrosion resistance of Ni-SiC composite coatings fabricated using electrodeposition method [82]. The microhardness, wear and corrosion resistance of the composite coatings increased with increasing SiC content in the plating bath. The increase in microhardness and wear was mainly due to incorporated SiC particles which restrain grain growth as well as plastic deformation and promotes the grain refining and dispersive strengthening. These effects became stronger with increasing inert particles content in the electrolytic bath. Nickel composite coatings showed wide passive region and smaller passive current density when compared to pure nickel coatings. The reinforced SiC particles act as a physical barrier to initiation and development of defect corrosion resulting in improvement in corrosion resistance of the composite coatings. Hou et al studied wear behaviour of electrodeposited Ni-SiC composites [96]. Nickel composite coatings exhibited maximum hardness and wear resistance compared to pure nickel coatings. For 2 vol% Ni-SiC composite coatings showed maximum fluctuation in coefficient of friction due to presence severe abrasive wear. For 11.5 vol.% nickel composite coatings showed decreased coefficient of friction due to low ploughing grooves. Worn out material from rotating steel ring i.e. iron oxide debris layer covered the worn surface and acts a lubricant between the contact surfaces and coefficient of friction decreases further.

Zimmerman et al analysed mechanical properties of Ni-SiC nanocomposites [97]. Nickel composites showed significant improvement in mechanical properties including hardness, yield stress as compared to conventional nickel composites. Tensile strength of composites was four times than polycrystalline nickel and two times higher than conventional polycrystalline nickel composites. The improvement in hardness of composites was mainly based on dispersion strengthening mechanism which is based on dislocation particle interaction.

Ni-TiO_2 composite coatings

Metal matrix composites with TiO_2 reinforcement exhibit photocatalytical behaviour with significant improvement in mechanical properties. Ni-TiO_2 composite coatings are widely used in fuel cell applications particularly in electro-oxidation of methanol. Baghery et al characterized corrosion and wear performance of Ni-TiO_2 composite coatings [84]. Micro hardness of Ni-TiO_2 composite coatings significantly improved than pure nickel coatings due to grain refinement strengthening and dispersion strengthening. The reinforced TiO_2 particles in nickel composite coatings reduced direct contact between abrasive surface and metal matrix. These separated particles act as a solid lubricant between two wear surfaces. Therefore, Ni-TiO_2 composite coatings exhibited higher wear resistance due to higher hardness and lower coefficient of friction. Presence of TiO_2 act as a physical barrier to the initiation and development of defect corrosion and it also inhibits localized corrosion, resulting an improvement in corrosion resistance nickel composite coatings. Lajevardi and Shahrabi studied the effect of pulse parameters on properties of Ni-TiO_2 composite coatings [58]. Microhardness of composite coatings increased with increasing current density from 2 to 5 A/dm^2 and after that it decreased as current density increases. Microhardness and particle reinforcement in composite coatings found maximum value for coatings deposited at 10 Hz frequency and 10% duty cycle.

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