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Nano Composites Surface Coatings Using Electro Deposition Technique-A Review

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ABSTRACT

This paper discuss on results of various researchers worked on nano composites coatings. Various materials like Ni/Sic, Ni-Cr, Co-Ni/Sic and Ni-Al2O3 are used as coatings on the substrate to improve the surface hardness. Electro deposition techniques were employed for coatings. The morphology about grain size was studied using scanning electron microscope. The properties like wear, thermal shock resistance, corrosion resistance and oxidation resistance were studied.

Keywords— *Nanocomposite coatings, hardness, mechanical properties, scanning electron microscope*

I. INTRODUCTION

Nanocomposite coatings cover more interest in recent years in surface coating technology, especially in industries like automotive, aerospace and electronics. Nanocomposite coatings will improve the mechanical properties of the materials like corrosion resistance, heat resistance, wear resistance, and scratch resistance. Compared to the traditional anticorrosive composite coatings, the superior performance of their nanocomposite counterparts is mostly attributed to the improved morphology with nano scale phase-separated domains. This article discusses about investigations and results of various researchers worked on nano composite coatings using Electro deposition techniques.

II. LITERATURE REVIEW

M Sindhuja et al. [1] have developed Nickel-Silicon carbide [Ni/Sic] nano composite coatings on graphite for various shapes to study the effect of the shape of graphite on morphological, composition and structural properties of nanocomposite coating using Electro deposition techniques. The morphology of electrodeposited coating was analyzed by SEM analysis; it was observed that highly porous composite coating with fine grain size with cracks in rod and square shape graphite substrate and less porous structure with fine grain size on circular shape graphite. Hence circular shape graphite has higher adhesion and thickness compared to rod and square shaped graphite. By surface analysis, circular graphite has lower surface roughness compared to rod and square. Low surface roughness is because of dense thick coating on a substrate. By thermal analysis, it was observed that the weight loss of coating due to oxidation is more in a square shaped substrate and less in circular graphite substrate. The circular graphite substrate coating is more resistance to thermal shocks and oxidation hence it can be utilized in higher temperature applications.

Mehran masoudi et al.[2] have developed Nickel-chromium[Ni-Cr], Nickel-Silicon carbide[Ni-Sic] and Nickel-Silicon carbide-chromium[Ni-Sic-Cr]nanocomposite coatings on pure copper samples using electro deposition. The characteristics of these coatings are investigated and compared using SEM, X-ray diffraction and wear test. It is observed that Ni-Sic-Cr nanocomposite coating have homogeneous and Cr particle in Ni-Cr and Ni-Sic-Cr coatings formed granular grain structure but Sic particle did not change the columnar structure of Ni. The hybrid composite Ni-Sic-Cr has higher hardness and wears resistance because of the fine crystalline structure.

Roseana florentinoet al. [3] has developed cobalt-Nickel-Silicon carbide [Co-Ni/Sic] nanocomposite coating electrodeposited on API 5LX80 steel. The morphology and chemical analysis of surface were analyzed by Scanning Electron Microscope coupled with Energy dispersive spectroscopy and related with micro hardness and X-ray diffraction. The result shows composite coatings have acicular morphology with higher hardness and higher corrosion resistance than a substrate.

Baosong li et al [4] has developed Nickel-cobalt-Silicon carbide [Ni-Co/Sic] nano composite coatings. The influence of Sic nano particle on the structure and morphology of Ni-Co coatings were studied by SEM. The results show that Sic nano particle promote nucleation and enhances the hardness of Ni-Co alloy. The cobalt enhances refinement phase and reduces porosity and thereby increases micro hardness. Corrosion resistance of nano composite coatings also increases because of the anticorrosion property of cobalt. Since the

increase in micro hardness and wear resistance properties these coatings have a vast application in the field of marine application.

Mohammed Islam et al. [5] have prepared electro less nickel-phosphorous-Silicon carbide [Ni-P/Sic] nanocomposite coatings with a small amount of Sic nano particles. Addition of Sic nano particle improves corrosion resistance and some mechanical properties like micro hardness.

Kailash hamal et al. [6] has developed Nickel-Silicon carbide [Ni-Sic] composite coating by electrode electrochemical decomposition technique. The effect of current density during the process of electro deposition is studied and it is observed that the 60mA/cm2 current density is the optimum value. At lower current density non uniform surface morphology was observed due to large grains processed by Ni-Sic. On the other side, the regular morphology was observed at the higher current density due to the fast deposition rate of Nickel at the cathode and second phases Sic particles on the growing nickel matrix. Due to the uniform distribution morphology at the higher current density, the micro hardness is observed to be maximum.

Mehran Masoudi et al. [7] have developed Ni–Al2O3, Ni–SiC and–Al2O3–SiC metal matrix composite nano coatings using electro deposition technique onto the pure copper substrate. The composition of the coating, crystalline structure and the surface morphology of the coatings were characterized by X-ray diffractometry technique and field emission scanning electron microscopy (FESEM). The results show that Ni–Al2O3–SiC hybrid composite coatings with uniform homogeneity and granular structure. The nano particles effectively increased the micro hardness and wear resistance owing to the dispersion and grain-refinement strengthening. The oxidation resistance of the Ni–Al2O3–SiC hybrid nanocomposite coatings was about41 % greater than the unreinforced Ni deposit and about30 % greater than the Ni–Al2O3 composite coatings.

Kailinzha oet al. [8] has prepared Ni-Al2O3 nanocomposite coatings by using the pulsed current-jet method to improve the surface morphology and mechanical properties of nanocomposite coatings. The effects of nano particle concentration and pulse current on the surface quality, grain size of nano particle and properties of the coatings were analyzed. The surface morphology of the nano coatings and the distribution of nano particles were analyzed by scanning electron microscopy [SEM]. The microstructure of the coating and the grain size of the nano particle were studied by X-ray diffractometer. The micro hardness was measured by micro hardness tester and corrosion resistance of the coatings was studied by the electrochemical workstation. From the results, it is observed that adding nano-Al2O3 solution by a proper amount can enhance the micro hardness and corrosion resistance property of the coatings. The coatings obtained by pulsed current-jet electro deposition method possessed better surface morphology, finer grain size than the coatings obtained by direct current-jet electro deposition method.

Maryam Afsharpour et al. [9] have proposed a method to protect old manuscripts by using ZnO nano composite coatings. Old manuscripts are subjected to environmental damage by bacteria, UV radiation, and pollutant gases. In this study ZnO nanocomposite used as a protective coating on the surface of old manuscripts like paper fibers. The layer of nanocomposite coating acts as a barrier. From results, it is observed that better stability and good light stability of papers with nanocomposite coating. The papers were tested with molds of bacteria to test antibacterial and antifungal properties of paper and the result observed to be positive.

III. CONCLUSION

This overview covers the fundamental and recent developments in design, preparation of the nanocomposite coatings. Nanocomposites coatings today become smatter, cheaper, and more functional. These nanocomposite coatings are expected to be larger in the future as anticorrosion barrier coatings, antibacterial coatings, self scratch repair, fire retardant coatings etc.

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