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A NEW STUDY ON THE NANO COATING MATERIALS IN CHANGING WORLD

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ABSTRACT

When the automobile body is baked at a higher temperature, the ceramic nanoparticles crosslink into a dense network instead of the long molecular chains found in conventional paint. This allows the lacquer to provide a much more effective scratch protection against normal wear and tear and allows the paint to retain its gloss. Shen et al. have re-emphasized the importance of nano-TiO_2 in the development of high corrosion resistance and hydrophobic coatings. Hydrophobic coatings with low wet ability are possible to effectively prevent the water on the substrate surface, and exhibit excellent corrosion resistance in wet environments. Hydrophobicity of the porous coatings is attributed to air trapped in the nanopores that limits water accessibility and concentration of corrosive species in the stainless-steel holes, and hence causes a retardation of the anodic dissolution process. The corrosion potential of the nano-TiO_2 and fluoro alkyl silanes/nano-TiO_2-coated electrodes is founding much nobler than that of the 316L stainless steel substrate in Ringer's Solution.

INTRODUCTION

Nanobiotechnology in modern era is regarded as the best scientific technological development ever made in twenty first century. The teem logy has proven a milestone journey with tremendous interdisciplinary applications in the myriad field of sciences. The term Nano biotechnology has been refined to those substance, materials, particles and tubes of less than 100 nanometer (nm) in at least one dimensions, may be prepared artificially with new properties which are of importance for the development of new product and application:

EXPLANATION

Ceramic Coatings:

Ceramic coatings are attractive as they possess good thermal and electrical properties, and are more resistant to oxidation, corrosion, erosion and wear than metals in high-temperature environments. Nanoparticles of diamond as well as chemical compounds used for hard coatings (Sic, ZrO_2, and Al_20_3) are commercially available[18] with typical particle sizes in the range (4-300 nm). Within tribology, a new development has been to deposit nanocoating's from colloids, e.g. of graphite. Nanosized silica has proved to be an alternative to toxic chromate conversion coating. Metal precoat based on the combination of a nanostructured metallic oxide of ceramic-type, with metals like Ti and Zr produces nanometer-range conversion coating, while the conventional phosphate layers are within micron range, Incorporation of suitable nanoparticles in paints for improved properties is well commercialized. During the painting process, e.g. of automobiles, the ceramic nanoparticles float around freely in the liquid paint. When the automobile body is baked at a higher temperature, the ceramic nanoparticles crosslink into a dense network instead of the long molecular chains found in conventional paint. This allows the lacquer to provide a much more effective scratch protection against normal wear and tear and allows the paint to retain its gloss. Shen et al. have re-emphasized the importance of nano-TiO_2 in the development of high corrosion resistance and hydrophobic coatings. Hydrophobic coatings with low wet ability are possible to effectively prevent the water on the substrate surface, and exhibit excellent corrosion resistance in wet environments. Hydrophobicity of the porous coatings is attributed to air trapped in the nanopores that limits water accessibility and concentration of corrosive species in the stainless-steel holes, and hence causes a retardation of the anodic dissolution process. The corrosion potential of the nano-TiO_2 and fluoro alkyl silanes/nano-TiO_2- coated electrodes is founds much nobler than that of the 316L stainless steel substrate in Ringer's Solution. Co-deposition of ceramic nano-scaled particles during the electroplating process brings improvements in technical properties at reasonable cost. However, the corrosion resistance deteriorated when the particles were co- deposited. Euler et al. produced a series of nickel nano-ceramic composites, with co-deposition of particles of Al_2O_3 and TiO_2 as a single primary particle in the nanometer range (10-30 nm) at one end of the scale and as agglomerates up to a size of a micrometre at the other. Successful incorporation of particles up to 2- volume % has been established despite the problem of possible agglomeration. The decrease in corrosion resistance is explained by an accelerated diffusion of chloride ions along the interface between nickel and the incorporated particles. The high surface energy and agglomeration tendency of the nanoparticles in highly conductive metal electrolytes will tend to impede uniform distribution of the *particles.*

Polymer coating:

Polymer coating Conducting polymers have evoked a great deal of interest due to their electrochemical properties and their mixed ionic/electronic conductivity properties, they have been used as host matrices in various composite films. Organic or inorganic particles can be mixed with or incorporated in the conductive polymers to modify their morphology, conductivity and different physical properties depending upon the application, such as corrosion protection. Polycrystalline nanocomposites that consist of conductive polymers were found to display novel properties. Nanoparticulate dispersions of organic metal polyanilines in various paints at low concentrations can cause tremendous effects in corrosion protection2. Melt dispersion of polyaniline leads to fine particles, which self-organize into complex ultra-fine networks. Some specific nano conduction polymers which enhance corrosion resistance are polyaniline, polythiophene and polypyrrole. To enhance the oxidizing power of the polymers, incorporation of strong oxidizing species in the polymer has been envisaged. Polypyrrolenanocomposites with oxides, especially with Fe_3O_4 have prospects for use in corrosion protection of iron, Polypyrrole nanocomposites with montmorillonite clay showed better corrosion protection compared to undoped polypyrrole, Nanostructured materials engineering extends the possibility of engineering 'smart' coating that can release corrosion inhibitors on demand when the coating is breached, stressed or an electrical or mechanical control signal is applied to the coating1, Inherently conducting polymer (ICP) films containing, inhibiting anions as the dopant anions can release them when the film is coupled to a breach in the coating. Research has developed chromate-free corrosion inhibiting additives in which organic corrosion inhibitors are anchored to nanoparticles with high surface areas that can be released on demand.

Self-assembled nanophase coating:

In the traditional sol-gel method, hydrolysis-condensation processes are followed by condensation polymerization upon film application. However, the evaporation process results in voids and channels throughout the solid gel and cannot provide adequate corrosion protection due to the high crack forming potential. Sol-gel technology has an important limitation related with the maximum coating thickness attainable; typically, lower than 2 mm. Studies showed that incorporation of nanoparticles to the sol can make it possible to increase the coating thickness, without increasing the sintering temperature". Electrophoretic deposition of commercial SiO_2 nanoparticles suspended in an acid-catalyzed SiO_2 sol on stainless steel substrates leads to coating as thick as 5 mm with good corrosion resistance2. Incorporation of nanoparticles in the hybrid sol-gel systems increases the corrosion *protection properties due to lower porosity and lower cracking potential. Incorporation of inorganic nanoparticles can be a way to insert corrosion inhibitors, preparing*

inhibitor nano reservoirs for self-repairing pre-treatments with controlled release properties. Studies showed that sol-gel films containing zirconia nanoparticles present improved barrier properties. Doping this hybrid nanostructured sol-gel coating with cerium nitrate brings additional improvement to corrosion protection. Zirconia particles present in the sol-gel matrix act as nano reservoirs providing a prolonged release of the cerium ions. The recent discovery of a method of forming functionalized silica nanoparticles in situ in an aqueous sol-gel process, and then crosslinking the nanoparticles to form this film, is an excellent example of a nanoscience approach to coating. This self-assembled nanophase particles (SNAP) surface treatment based on hydrolyzed silanes, containing a crosslinking agent substantially free of organic solvents and Cr-containing compounds promotes adhesion of overcoat layers more effectively. Unlike chromate-based treatments SNAP coatings provide barrier-type corrosion resistance but do not have the ability to leach corrosion inhibitors upon coating damage and minimize corrosion of the unprotected area2. The SNAP surface coating could replace the currently used chromate containing surface treatment and can provide the basis of long-lived coating for aluminum alloys 531, The ability to design coating components from the molecular level upward offers potential for creating multifunctional coatings. Molecular simulation approaches have been used to enhance the understanding of complex chemical interactions in coatings related process Self-cleaning paints and biocidal coatings:

There is a great interest in the design and development of surfaces that not only provide biocidal activity but are easy to clean and even self-cleaning. Most of such coatings acquire their biocidal/self- cleaning capacity by incorporating specific nanoparticles: basically silver (Ag) and titanium oxide (TIO_2). Nano TiO_2 is used for developing anti-UV, antibacterial and self-cleaning paints. This possesses self-cleaning hydrophobic properties, which causes water droplets to bead- off a fully cured surface picking up dirt and other surface contaminants along the way. This self-cleaning action helps clean and maintain important surfaces and to accelerate drying, leaving the surface with minimal spotting. A recent study by Cai et al. utilizes corona treatment technique, inert sol-gel coating and anatases$_2$layer. With the corona treatment, an organic surface was activated to allow a uniform TiO2sol
-gel coating. Nanoparticles of surfactant Al_2O_3 molecules help increase hydrophobicity and increase scratch resistance. Microbial evolution on a wide variety of surfaces can cause corrosion, dirt, bad dour and even serious hygiene and health problems. AMBIO (Advanced Nanostructured Surfaces for the Control of Biofouling) a European Union research project is investigating how to prevent the build-up of organisms on surface

under marine conditions to avoid biofouling. The project aims to use nano structuring to significantly reduce the adhesion of organisms to surfaces in aquatic environments, and thus control the fouling process without the use of toxic biocides such as copper and organotin compounds that prevent fouling by killing organisms. Nano structuring of the surface alters the wetting properties and is intended to signal that the site is not suitable for the organisms to settle the project aims to synthesize new nanostructured polymers that are stable under marine conditions. Although no alternatives to the use of biocides are available at present, creation of nanostructured surfaces could offer an innovative and environment- friendly solution to the problem of biofouling. Research has developed new biocidal coating systems that prolong biocidal activity by immobilizing.

Such additives on nanoparticles; the embedded biocides are designed to be released into the environment only when needed, thus extending the-lifetime of the biocidal activity.

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