IOP Conference Series: Materials Science and Engineering

PAPER • **OPEN ACCESS**

Short review on nanocomposite coating advances in the industry

To cite this article: O.A. Emmanuel *et al* 2021 *IOP Conf. Ser.: Mater. Sci. Eng.* **1107** 012069

Short review on nanocomposite coating advances in the industry

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Abstract
Study on the nanocomposite coating is on increase due to their multifunctional characteristics in industries. Nanocomposite coatings are made up of two or more immiscible nanomaterials which can also be detached with the purpose of providing mechanical properties that make them strong. It has also been of great importance in minimizing deterioration and biofouling impact. This coating has a great aplication in automotive, aerospace, seawater condensers and tubes, electronic industries, water electrolysis, energy generation. Furthermore, it has also enhanced the growth of paints and its properties in industrial production. Due to its properties, they are utilized in contruction firm, medical area, etc. Despite the aforementioned, nanocomposite coatings has increase in recent years as a result of advancements of nanoparticle manufacturing processes.This paper provides a brief review on nanocomposite coating in industry with focus on the effect, role, types and its application.

Keywords: Nanocomposite coating, industry, manufacturing

1. Introduction

Nanocomposite coatings is a material consisting of minimum two immiscible phases that can be detached by the use interface region with aim of giving greater mechanical properties that make them rigid [1], and posses quality resistance to deterioration and wear [2]. In industry, it has enhanced the growth of paints and its properties which includes cleaning [3], scratching and wear resistance [3]. These coatings can be categorized to metallic and ceramic nanocoatings comprising of more than one material in the Nano scale. Furthermore, nanocomposite coatings have been of utmost benefit towards minimizing deterioration and biofouling impact. They are made to react to pH, humidity, heat and so on. Their reaction brings about the release of certain quantity of inhibitor in other to correct damages due the effect and defects [3,5]. Nanocomposite coating fundamental element is the presence of the matrix as

IOP Conf. Series: Materials Science and Engineering 1107 (2021) 012069 doi:10.1088/1757-899X/1107/1/012069

the main materials of great properties that enhances the filler been placed[8], Sometimes it may be ceramic metal or polymers with dimension eater than nanoscale The aim of two dissimilar material compositions in single coating is to acquire a new nanocomposite material with distinctive characteristics, when compared to what each substance will offer. Nanocomposite coating have provided a great improvement in the mechanical properties, and also increased corrosion resistance [9]. This has led to an increase in density of grain boundaries, interphase boundaries, dislocations, etc. As a result of the fine particulate nature used in this nanocomposite coating, space filling and abrasive features blockage is therefore applicable from disseminating into the area of the substrate, thereby increasing the efficacy.

2. Effect of Nanocomposite Coating

Nanocomposite coatings impact the consistency and exterior features such as resilience, strength, and ability to deform under tensile strength [28]. It might not act as protective surfaces in most situations but still an efficient barrier that allows passivated ions to move quickly and give the protective nanolayer an enhanced grip of the substrate. [26].Moreover, nanocomposite coatings create a barrier platform with the aim of forming a more effective passivation layer. However, when there is an increased dispersal of aggressive ions, the collection of these nanosized materials will likely occur, bringing about uneven surfaces and causing an increase active sites emergence, thereby reducing corrosion resistance [18].

2.1. Types of Nanocomposite Coating with their Application

2.2 Metallic Nanocoating

This comprises of more than a lone pure metals which includes, Nickel, Tungsten, Zinc, Cobalt, Iron, Copper, etc. An unalloyed metal can be used in nanocomposite coating [10,11], or alloyed with the aim of improving its characteristics. In this case, improvement is strengthened by the utilization of nanosized coating, this is because, the behavior of nanomaterials is different when compared with micromaterials [12].This coating have a great application in industries such as, electronic industries, energy generation[6], tubes and sea water condensers, it can also be applied in aerospace[13] and automobiles.

2.3 Polymeric Nanocomposite Coatings

This coating has been of great use towards the prevention of deteroration corrosion as a result of the superior properties they posses. Polymer nanocomposite are formed when fillers are placed into a polymer [9,12].Normally,the essence of the nanofillers within the polymer matrix is to improve rigidity, firmness, resistance to heat, saturation, specific conductance, the solvent will minimize attack, combustibility, blighting, retain length, transparency, thickness and expense[15–16].

2.4 Waterborne Polymer Nanocomposite Coating

Waterborne polymer coatings have great properties such as environmental friendliness, minimal internal layer of friction, zero toxicity and easy cleaning [5]. The glaze disseminates by utilizing moisture as a dissolver. It is homogenised with nanomaterials for example, $Fe3O4$, $Fe2O3$, and ZnO due to its corrosion behaviour

[17, 18, 19]. Water supported coating is a common method an example of which is, water-based alkyds coating, which is regarded as one of the most cost efficient which can be sprayed on or immersed. Epoxy coating serves as a deterrent to regulate surge of forceful species and preserve the superficial layer of the alloys and metals against corrosion. In addition, due to the increase in the amount of Fe3O4 nanoparticles within the coating material, a locking effect is observed, this acts as a enduring barrier between the coating and the metal thereby, lining the nonvisible crevices that is, microcracks, thereby disallowing the infiltration of corrosive ions to the coated metal surface [14].

3. Effects of Nanocomposite Coating in Industry

3.1. Scratch Resistant, Nanocomposite Clear Coatings

Silica was the most common substance used in augmenting clear coatings on acrylic eyeglass lenses, topcoat for automotive, floor wear layers and multiple use scratch resistant polycarbonate sheets, to mention but a few. Comtemporary technological advancements have brought about the availability of multiple sources of inorganic nanoparticles. Globally, a number of companies have had colloidal silica in particle size range from 2 to 100 nm, both in aqueous and igneous forms. It has been available for decades and nano-sized that is highly concentrated colloidal silica dissipated through UV curable monomers has also become common. This form of colloidal silica is used in the preparation of UV cured coating which has better chemical, abrasion and scratch resistance which in turn improves film and gloss clarity and keeps it durable [22-25]. Aluminum silicate nanoparticles being used in automotive coating [19,20] was patented by PPG industries in 2002 with brand name CeramiClear. The CeramiClear coating system was used in Mercedes automobiles touting improved scratch resistance clear coat achieved by integration of silica nanoparticles [26].

3.2. Anticorrosion

The impact of nanocomposites in barrier films for packaging implementation has been analyzed in relations with other methods. One to two micron thick coating of this nanocomposite has shown to be as effectual as a 12 micron thick layer of ethylene vinyl alcohol barrier for PET [29, 32].

3.3. Optimization of infrared, ultraviolet and Other Radiation

Nanocomposite coating is critically important in regulating the impact of electromagnetic radiation on different surfaces. Coating formulation is been determined by electromagnetic frequency range of interest. Protracted exposure to U V radiation brings about the breakdown of coating films, it is therefore necessary to incorporate special additives minimize coating degeneration[15]. Degradation of ultraviolet radiation is a serious problem in automobile and aircraft coatings. Regulating the impact of infrared waves is a highly desired feature of nanocomposite coatings this is seen in heat protection of window glasses and shielding military vehicles from infrared detection [23, 33].

3.4. Role of Nanocomposite Coating in Industry

As a result of the exceptional characteristics that the nanocomposite coating displays, they are incorporated in everyday items which include mobile phones, clothing, computers, optics wares, etc. Construction firms utilized them in walls, tiles, window panes, flooring to mention but a few [28], Nanocomposite coating utilization in everyday appliances enables it to be scratch resistant, resilient coating, corrosion resistant, conductive and flame-retardant. In the medical field, metallic nanocoatings are utilized to alter the peculiarities of surfaces when required. Furthermore, they are also used for etch protection, drug delivery and biocompatibility [19] Despite the numerous properties of nanocomposite coating, they also play critical impact the environment, military, energy structure, automotive industry and so on and so forth [30-34].

Conclusion

The deterioration behaviour of nanocoatings in industry is restricted by several factors which include the environment, the substrate, the nanocoating component, etc. Despite the anomaly, nanocomposite coatings have increase in recent years as a result of advancements of nanoparticle manufacturing processes. Owing to the aforementioned facts and results, more study is still been carried out to efficiently implement the conditions and processing techniques of several nanocomposite-coating processes.

Acknowledgement

The authors will like to appreciate partial support of Covenant University toward completion of this work

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