CERAMIC COATINGS FOR INHIBITING THE BIO-CORROSION IN FOOD INDUSTRIES

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Corrosion is a result of series of electrochemical reactions that takes place between the metal surface and the aqueous medium. It is the deterioration of metals or its properties when it reacts with the surrounding environment. The best-known examples of metallic corrosion are rusting of iron and steel, tarnishing of silver and copper, dulling of brass and fogging of nickel. Microbiologically-influenced corrosion (MIC) or Bio Corrosion has been thought of mainly in anaerobic atmosphere where sulfide-producing bacteria are active. Since then different types of microbes, including aerobes have been considered in MIC. Corrosion may happen on a submerged metal surface due to uneven microbe colonization.

Microbial activities are an important concern in food industries, Pharmaceutical, transportation, oil and gas production. As infrastructures in those industries are aging, biocorrosion is becoming major risk factor. Corrosion is centric factor in all process industries across the globe. According to the National Association of Corrosion Engineers International India Section (NACE), the annual direct cost of corrosion in India may be 4% GNP (Gross Domestic Product), which is predictable to be around Rs.350 billions per year. The solution to reduce this phenomenal loss is to ensure that industries take up corrosion prevention as an important issue even at the design state. MIC or biocorrosion is a destructive type of corrosion, which is facilitated, initiated or accelerated by the presence and activity of bacteria. MIC significantly impacts several industries such as water, marine, and oil/gas industries. In food processing industries, formation of biofilms are the major concern they form biofilms on the surface of metal equipment which in turn affects the safety and quality of final product. Microbes perform variety of metabolic reactions and the resulting products may weaken the underlying substratum. These reactions are called as biocorrosion when the substratum consists of metal alloy or metal. Various species of microorganisms are able to collectively carry out metabolic activities that are potentially more corrosive to the underlying surface

than could be achieved by a single species acting alone. These features of sessile microbial growth represent important prerequisites of biocorrosion.

Steels are a group of metal alloys that are less resistant to MIC; steels are primarily used in marine industries, because of their good mechanical properties and relatively low cost. However, their common limitation is that they are not immune to MIC. It is documented that biofilms are capable of influencing electrochemical processes at the metal surface, often leading to deterioration of metals referred to as biocorrosion or microbiologically influenced corrosion. Growth of biofilms in food processing environments leads to increased opportunity for microbial contamination of the processed product. Among the numerous concerns with biofilm formation, biocorrosion is of particular importance in industry, because structural integrity may be compromised, leading to technical failures. In the food industry and medical field, biofilms also pose health risks. Hence, the attention is focused towards the inhibition of bio corrosion by ceramic coatings in the food industries.

Coatings are used in the food processing industry to protect surfaces from extreme temperatures and long operation cycles. Coatings that offer anti-stick properties to enable ease of content release from molds help to improve plant efficiency and product quality. In addition, there is a rising need to ensure food safety of processed food. Increase in incidences of food-pathogen related infections transferred to humans from consumption of processed food have led to demand for innovative coating technologies that aim to improve food quality and safety. This encompasses protective and functional coatings such as antimicrobial coatings for anti corrosive property.

In this work, the nanostructured titania (titanium oxide –TiO_2) coatings are deposited on Stainless steel surface by DC/RF magnetron sputtering technique. The effect of nanostructured titania coatings on antibacterial activity, biocorrosion, hydrophilic nature, long term efficiency of coating are studied. The XRD test results indicated the polycrystalline tetragonal structure of titania. The corrosion tests indicated the corrosion inhibition on the titania coated SS as compared to the uncoated SS. Therefore from the proposed method, it is possible to avoid the contamination in the food products process industries.