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Research article

Surface modification of hybrid composite multilayers spin cold spraying for biomedical duplex stainless steel

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ABSTRACT

The performance of biomaterials in biological systems is of critical significance for advancing biomedical implants. Duplex Stainless Steel alloys are the major biomaterials due to their significant characteristics. Many functional coatings are deposited on DSS alloy surfaces utilizing numerous surface coating techniques to improve their bioactivity and protect them from corrosion degradations. Coatings of titanium dioxide (TiO_2), Hydroxyapatite (HA), and zinc oxide (ZnO) have received considerable attention in the field of surface bioactive modification of DSS alloy implants. The coating techniques play a key role in increasing the required biological characteristics of DSS alloys, such as biocompatibility, mechanical properties, and corrosion resistance. In this regard, HA-ZnO, HA-TiO_2, and TiO_2–ZnO from each coating group are divided into single, double, and triple layers. These coatings were prepared by cold spray and deposited on the surface of the DSS alloy, followed by a heat treatment at 250 °C. The surface morphology of coated surfaces was analyzed utilizing field emission scanning electron microscopy (FESEM), atomic force microscopic (AFM), microhardness test, corrosion test in Ringer solution, and antibacterial test. The coatings showed nano-scale surface morphology with advanced crystallization and homogeneous structures; in the corrosion characteristics utilizing potentiodynamic polarization, triple layers of HA-ZnO coatings displayed advanced nanostructures with higher hardness values (514.75HV). The antibacterial test showed the triple layers of HA-TiO_2 and two layers of TiO_2–ZnO sensitivity to positive bacteria.

1. Introduction

"Biomaterials" refers to nonviable materials designed to interact with biological systems to assess, treat, enhance, or substitute any tissue, organ, or bodily function [1]. A new biomaterial's mechanical, functional tissue pathobiology and structure designated anatomic location, as well as other property regulation, standardization, ethics, the healing process, biocompatibility, toxicology, and

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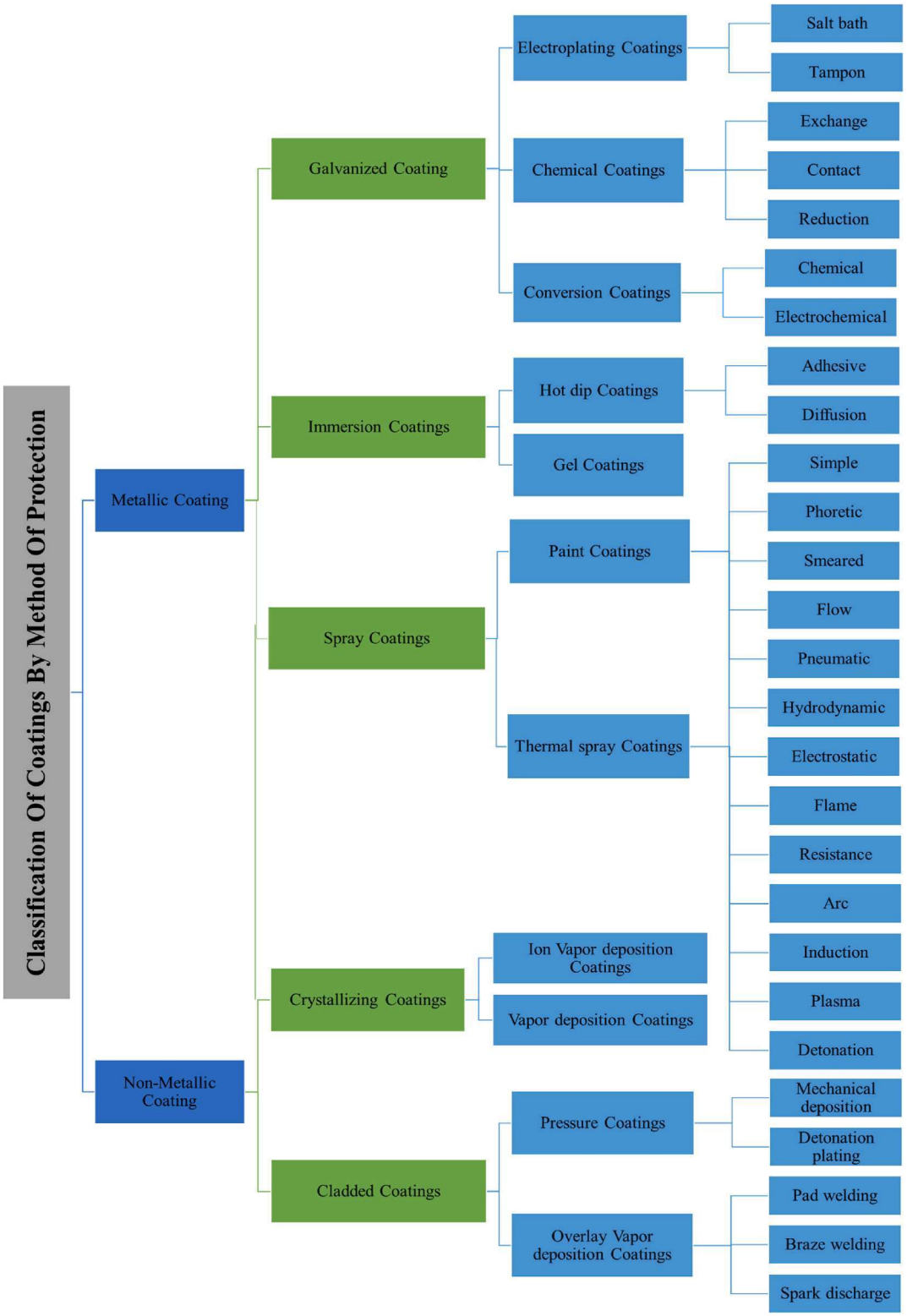

Fig. 1. The schematic diagram for coatings categorization.