TRIBOLOGICAL AND PROTECTIVE COATING SiOx MATRIX_Ni NANOWIRES

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In many industrial applications, metallic materials often exhibit poor resistance to corrosion and wear. Ceramic coatings have emerged as one of the most effective solutions for protection against the abrasive and corrosive nature of such environments [1]. The synthesis of ceramic coatings (Al_2O_3, ZrO_2, SiO_2) through sol-gel technology offers several advantages. It is relatively inexpensive, simple, environmentally friendly, and results in layers with excellent mechanical and physical properties. These coatings are thermally stable at high temperatures and highly biocompatible, making them ideal for applications in aerospace, electronics, marine, architectural and biomedical sectors [2].

In recent years, there has been considerable focus on enhancing the tribological properties of sol-gel coatings through modification with carbonaceous nanocomposites or metallic nanostructures with magnetic properties. These materials possess intrinsic toughness and low shear strength. The effects of doping Al_2O_3 sol-gel with graphene, as well as the integration of SiC particles in SiO_2 sol-gel coatings, are currently being investigated [3]. The results obtained so far are very promising, as these additives serve as solid lubricants, significantly reducing the friction coefficient (COF) and enhancing the corrosion and wear resistance of the coating.

The present work reports the outcomes of surface modification of galvanised steel samples (DX51D+Z) with a bifunctional sol-gel_SiOx_Ni-nanowires coating. This coating is both corrosive and tribologically active, effectively isolates the substrate from aggressive environmental factors, while decreasing the wear rate and COF by up to 25 % compared to unmodified materials (see Figure 1). In this case, the silicon sol-gel matrix has been additivated with Ni nanowires (Ni-NWs). Ongoing investigations are concentrating on determining, through directed synthesis, the impact of the morphology of these nanostructures (specifically their length-to-diameter ratio) on the functional performance of the monolayer, particularly its anti-wear characteristics.

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Figure 1. Protective effect of SiOx_Ni-NWs sol-gel coating on DX51D+Z galvanised steel