Effect of Titania Nanoparticles Loading in Sol-Gel Films for Corrosion Protection of Aluminum AA2024-T3 Alloy in 3.5% Sodium Chloride Solution

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Sol-Gel films modified with titania (TiO_2) was prepared and employed as a corrosion protective coating for aluminum Al2024 (UNS A92024) alloy in 3.5% sodium chloride solution. The morphology of the coatings was analyzed using field-emission scanning electron microscope (FESEM). The protective nature of the coating was evaluated using electrochemical polarization and impedance spectroscopy measurements. The results indicated that the modification of the sol-gel coating with TiO_2 increased the corrosion resistance of the alloy. The insulating and non-permeable nature of the coating resulted in a slower rate of electrolyte penetration to the underlining of the coating. On the other hand, the presence of TiO_2 allowed the modification of the sol-gel structure that ended with a high cross-linked structure. However, we found that increasing the Ti-content allowed high chance for galvanic corrosion that resulted in increasing the corrosion rate. The electrochemical impedance spectroscopy measurements provided an explanation for the increased corrosion resistance of the sol-gel coating containing TiO_2 . The surface morphology revealed changes imparted to the surface with and without coating before and after its exposure to the corroding medium.

Keywords: Al2024-T3; Sol-gel; Titania nanoparticles; Corrosion protection; 3.5% NaCl.

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