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Effect of ZrO_2:SiO_2 dispersion on the thermal stability, mechanical properties and corrosion behavior of hybrid coatings deposited on carbon steel (Article)

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Abstract

In this work we present the development of a nanocomposite material composed by ZrO_2:SiO_2 (25:75 mol%) nanoparticles in a polyurethane (PU) matrix for corrosion protection of AISI 1018 carbon steel. Specifically, the effect of the pre-dispersion method of ZrO_2:SiO_2 nanoparticles to reinforce PU coatings in delayed the corrosion and enhance mechanical properties of mild steel, were analyzed by applying two conventional methods: mechanical stirring (1, 3 and 5 h) and sonication (30, 60 and 120 min). The effect of pre-dispersed the ceramic nanoparticles by mechanical stirring and sonication on the mechanical properties and corrosion behavior was analyzed. Sonication improved the dispersion and hardness properties reducing the time of dispersion of the nanoparticles in comparison with mechanical stirring. The EIS results also showed that the hybrid coatings using sonication as method to pre-dispersed the nanoparticles enhanced the dispersion and the degradation resistance of the carbon steel by more than two-order of magnitude as compared to the coated samples with pure polyurethane after 2 h exposure in 3 wt.% NaCl solution. Long-term (20 days) EIS results also confirmed that the hybrid coating synthesized with sonically pre-dispersed particles improved the mechanical properties and degradation resistance in comparison with that observed with coatings using pre-dispersed particles by mechanical stirring, which could be better in service mechanical integrity.

Author keywords

EIS; Hybrid coatings; Mechanical properties; Mechanical stirring; Sonication