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# CORROSION RESISTANCE OF BIFRACTIONAL TEXTURE COATINGS

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**Abstract:** The study examined the resistance of micro- and nano-textured coatings to corrosive environments and water immersion. The coating is made using modified calcium carbonate microparticles and treated colloidal silica nanoparticles. This work uses electrochemical methods as a conducting electrochemical impedance spectroscopy and potentiodynamic polarization curve measurements to study the degradation mechanism of polymer coatings in corrosive environments. The composite coating, as suggested by this study, exhibits notably stable water resistance, and demonstrates robust corrosion resistance when exposed to corrosive environments. Such promising attributes position the coating favorably for various practical applications.

**Key words:** coatings, corrosive resistance, electrochemical, calcium carbonate,

The experimental procedure involves preparing nanoscale and microscale fillers, including 5 wt. % Aerosil R972 and 90 wt. % hydrophobized calcium carbonate ($CaCO_3$), along with 5 wt. % styrene-butyl methacrylate copolymer (AC) [1]. Subsequently, the hydrophobized fillers are applied onto mirror-polished aluminum plates using a polymer filler solution. After drying the coated panels, they are compared with reference samples, followed by conducting surface characterization analysis to evaluate the efficacy of surface modification for tailored surface properties. Following coating application and drying, the experimental procedure involves testing the temporal evolution of surface contact angle upon immersion in water and conducting electrochemical impedance spectroscopy and potentiodynamic polarization curve

measurements using an electrochemical workstation BP-300 (Biologic, France) to assess the surface properties of the samples [2, 3].

It can be hypothesized that the introduction of water may induce a reduction in the interfacial adhesion between the polymer matrix and filler particles, potentially leading to localized accumulation of water at the polymer-particle interface. Consequently, a decrease in the contact angle on the coating surface is anticipated (Table 1).

**Table 1 – Surface characterization of the water resistance, corrosive resistance (water contact angles, deg.)**

| | | | | |
|---|---|---|---|---|
| C(water) | Duration of immersion in water, hours | | | |
| | 0 | 24 | 48 | 72 |
| | 146° | 135° | 134° | 134° |
| C(corrosive) | Duration of immersion in 3,0 wt. % NaCl solution, hours | | | |
| | 146° | 134° | 134° | 133° |

Figure 1 shows the surface potential of the coating after 72 hours of immersion in a corrosive environment. Potential increased while the current density decreased. This phenomenon suggests that although the outermost layer of the coating may have corroded during the exposure, the underlying layers continued to provide corrosion protection, resulting in an overall increase in potential. This observation implies the exceptional corrosion resistance capability of the coating, as it effectively retards corrosion progression and preserves the integrity of the substrate.

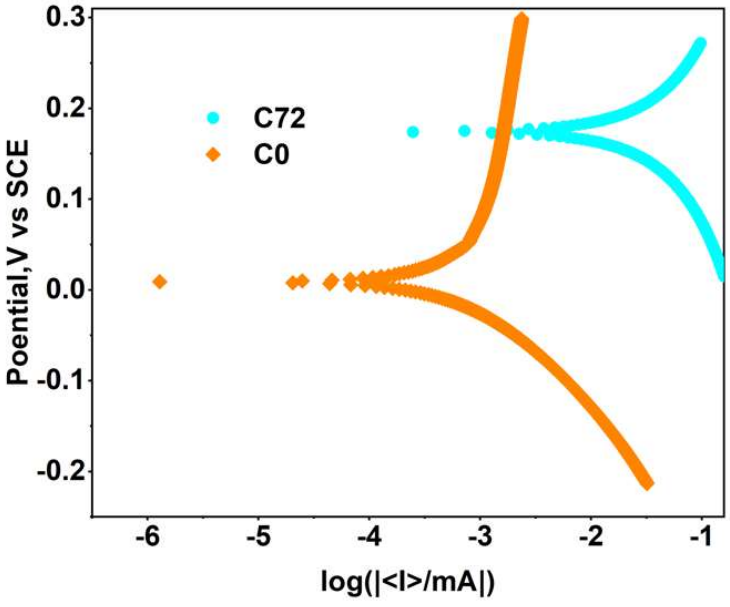


**Fig. 1. Polarization curves of different electrodes, where: Sample (C0) and Sample (C72) after immersing in a corrosive environment for 72 hours**

Figure 2 shows the results of the AC impedance spectra of the samples, the AC (alternating current) impedance spectra of samples C0 and C72 exhibit a remarkable close overlap, indicating the robust corrosion resistance of the coating. This suggests that significant corrosion-induced changes in the impedance spectra, which would have indicated substantial surface degradation, are not observed.

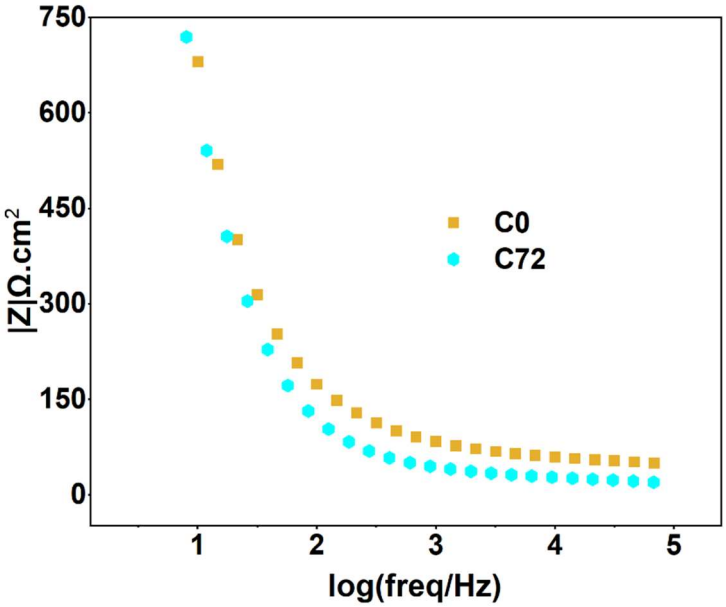


**Fig. 2. Bode plots of the EIS results for different specimens, where: where: Sample (C0) and Sample (C72) after immersing in a corrosive environment for 72 hours**

## ВИСНОВКИ

The researchers investigated the resilience of micro- and nano-textured coatings under challenging conditions, including corrosive environments and water immersion. These coatings are fabricated utilizing modified $CaCO_3$ microparticles and colloidal silica nanoparticles. The composite coating, as suggested by this study, exhibits notably stable water resistance, and demonstrates robust corrosion resistance when exposed to corrosive environments. Such promising attributes position the coating favorably for various practical applications.

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