

## Enhancing Corrosion Resistance of 7050 Aluminum Alloy by Hydrophobic h-BN Nanosheet-Reinforced Chlorinated Rubber Coatings

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**Abstract** The continuous degradation of metallic surfaces by corrosion is a critical issue that affects the structural reliability and performance efficiency in various industrial sectors. This study focuses on the enhancement of corrosion resistance for 7050 aluminum alloy through the integration of hydrophobic hexagonal boron nitride (h-BN) nanosheets and chlorinated rubber coatings. Utilizing a mechanical exfoliation method, hydrophobic h-BN nanosheets (BNNS) were produced from bulk h-BN followed by a modification process to induce hydrophobic properties. The nanosheets underwent characterization using scanning electron microscopy (SEM), transmission electron microscopy (TEM), and atomic force microscopy (AFM) for morphological characterization, alongside X-ray diffraction (XRD), X-ray photoelectron spectroscopy (XPS), Raman spectroscopy, and energy-dispersive X-ray spectroscopy (EDS) for phase analysis, ensuring the BNNS' suitability for improving corrosion resistance. The efficacy of the BNNS-based coating on 7050 aluminum alloy was evaluated through potentiodynamic polarization, electrochemical impedance spectroscopy (EIS), and salt spray testing, demonstrating an improvement in corrosion resistance. XRD analysis confirmed the successful exfoliation of h-BN and the enhancement of the (020) crystal plane, suggesting the introduction of structural defects that promote vertical lattice plane exposure. The hydrophobicity of the BNNS-reinforced coatings, quantified by contact angle measurements, showed a substantial increase by 66.7% compared to chlorinated rubber coatings without BNNS. Electrochemical tests indicated a positive shift in the corrosion potential and a decrease in corrosion current density, both indicative of order-of-magnitude reduced corrosion. This research presents hydrophobic BNNS as a strategy for corrosion mitigation on 7050 aluminum alloy, offering a physical barrier that minimizes water-metal interactions and slows electrochemical corrosion processes. The findings contribute to the nanomaterial-based coatings research for corrosion protection, with broad implications for aerospace, automotive, and civil infrastructure industries. The use of hydrophobic BNNS-

reinforced coatings represents a notable advancement in the field of material preservation technology, providing insights into nanomaterial applications and facilitating the development of enduring and economical solutions to enhance the longevity and dependability of 7050 aluminum alloy components across diverse environments.

**Keywords** Corrosion Resistance; Hexagonal Boron Nitride; Nanosheets; Hydrophobicity; Surface Modification