Investigation of Interaction Behaviors and Mechanisms between Aerospace Materials and Microorganisms under Different Gravitational Conditions

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Abstract With the rapid advancement of aerospace technology, microbial-induced corrosion in space environments has become a growing concern. To uncover the long-term potential risks posed by microbial corrosion under space conditions, this report systematically reviews three major research methods: ground-based experiments, simulated microgravity experiments, and in-orbit experiments. Our recent work focuses on the interaction mechanisms between aerospace materials, including aluminum alloys, magnesium alloys, and printed circuit boards, and microbes under different gravity conditions. The study shows that microbial growth and metabolic characteristics, such as biofilm structure, ultrastructure, and metabolic byproducts, exhibit significant variations across different gravity environments, altering the interaction interface between microbes and materials, which in turn affects corrosion and degradation behavior. Notably, in the long-term operation of space stations, microgravity changes mass transfer and surface liquid film distribution on material surfaces, leading to differentiated microbial growth behaviors and more pronounced lateral and vertical corrosion propagation. As a result, conducting authentic, long-term in-orbit experiments is essential for the accurate life prediction of aerospace materials and the development of new materials, providing critical scientific insights and technical support.

Keywords Microbiologically influenced corrosion; Aerospace materials; Space on-orbit experiments; microgravity simulation experiments

Reference

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