Simulation study on corrosion damage of aircraft lightning protection lap wire based on cellular automata method

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Abstract Copper conductor, due to its low resistivity, ductility and other advantages, is often used in aircraft lightning protection lap wire[1]. Aircraft lightning protection lap wire is a stable low impedance electrical path which is an important guarantee of aviation equipment to resist lightning. With the increase of the service time of the airplane, corrosion will lead to the increase of its resistance, and then affect its ability to resist lightning, which will cause great threat to the flight safety of the airplane[2]. Therefore, it is necessary to predict the corrosion damage process of the lightning protection lap wire and its effect on the resistance.

In this paper, the corrosion model of the lightning protection lap wire is established based on the cellular automata algorithm. According to the corrosion process of metal dissolution, corrosion product generation, acidic hydrolysis, etc, copper, cuprous ions and other cells are set up to simulate the damage evolution process and the trend of corrosion weight loss. Then the discrete points are transformed into a grid, and then into a solid, retaining the complex irregularity of the etch pit morphology. The corrosion pit morphology is imported into COMSOL to simulate the trend of resistance. The damage evolution process under real conditions is simulated by immersion corrosion experiments that verify the accuracy of the simulation. The results show that in the corrosion process of the aircraft lightning protection lap wire, the corrosion weight loss grows faster in the early stage and slows down gradually in the late stage, and its resistance also grows faster in the early stage and slows down gradually in the late stage. Therefore, the research in this paper is of great significance for predicting the corrosion damage of aircraft lightning protection lap wires and the resulting changes in the resistance value.

Keywords Aircraft lightning protection wires; Cellular automata; Finite element analysis; Corrosion damage

Reference

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