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流体力学与飞行力学

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用于碳纤维复合材料的电热除冰技术实验研究

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Experimental Study on Electro-thermal Deicing Technique for Carbon Fiber Composite

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摘要

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摘要 针对碳纤维复合材料机翼的电热除冰技术研究现状,提出了采用多层材料结构的电热除冰垫技术方案.该电热除冰垫各层均由具有不同热功能的材料构成,其中部分材料为根据性能需要自行制备得到的.采用有限容积法(FVM)对除冰垫的性能进行了数值模拟,确定了隔热层厚度,验证了加热回路的均匀性.根据所确定的方案制备了电热除冰垫,并利用自行搭建的除冰验证装置对该电热除冰垫的性能进行了实验研究,得到了加热热流密度、来流风速、来流与除冰表面间夹角对除冰性能的影响规律.研究表明,该电热除冰垫具有良好的除冰性能,除冰方案可行.

关键词: 碳纤维 电热除冰 多层材料结构 物性测试 除冰验证装置

Abstract: Based on recent research of electro-thermal deicing technique for carbon fiber composite airfoil, a multi-material structure is proposed. The deicer pad consists of multi-materials, each with specific thermal properties. Some of these materials are manufactured in the laboratory based on the property requirements. The finite volume method (FVM) is adopted to simulate the performance of the deicing pad, and the proper thickness of the insulation layer is determined. Through numerical simulation the uniformity of the heating circuit is also verified. According to the scheme an electro-thermal deicer pad is developed, and a deicing validation device is designed and adopted to carry out the experimental study on the performance of the deicer pad. The impact of heat flux, airflow velocity and the angle between the airflow and the deicing surface on the deicing performance is studied. The study shows that the electro-thermal deicer pad so designed is able to provide good deicing performance, and that the proposed deicing scheme is feasible.

Keywords: carbon fiber electro-thermal deicing multi-material structures physical property measurement deicing validation device

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