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Author: Dr. mengmeng gong
China Academy of Launch Vehicle Technology (CALT), China, gmm101@sina.com

RESEARCH ON THERMAL PERFORMANCE OF ACTIVE COOLING WING LEADING EDGE MANUFACTURED BY RAPID PROTOTYPING PROCESSES

Abstract

When the aircraft is flying at a high Mach number, it will generate severe aerodynamic heat on the surface of the aircraft, especially on the surface of leading edge, so it is desired to overcome the weight and temperature limitations of thermal protection systems; This paper introduces an noval wing leading edge structure schemeisin with cooling channels, it is manufactured by rapid prototyping processes , using of titanium powder as raw material . As fuel flows through the snake-shaped channels inside the leading edge structure, heat from air friction is taken away soon and the fuel is warmed up.Therefore, the impact of aerodynamic heat on the thermal protection system is greatly reducedMeanwhile, wing leading edge is manufactured in sandwich micro truss structure, except the part of the cooling channels.sandwich micro truss structure. Taking advantage of its lightweight and high-strength features, the effect of efficient carrying mechanical loads can be achieved while reducing weight. To verify the effectiveness of active cooling wing leading edge, aerodynamic heating is simulated with iodine tungsten lamp array on the ground. Besidesconnecting the refrigerator to the cooling channels via an intermediate heat exchanger, so that , the heat is finally transferred to the refrigerator. Based on the aerodynamic heating simulation system, thermal performance of active cooling wing leading edge structure were tested in which water and oil as the working fluid, under radiant heating conditions.The experimental results show that, active cooling wing leading edge structure can not only achieve weight reduction, but also achieve rapid cooling, this result provides the reference for the design of wing leading edge structure in the future.