Paper ID: 44574
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IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Advanced Materials and Structures for High Temperature Applications (4)

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AERODYNAMIC HEATING RESEARCH OF SCRAMJET INLET THROUGH THE DUPLICATING HYPERSONIC FLIGHT CONDITION WIND TUNNEL

Abstract

At hypersonic flight conditions, particularly for a long time fly, the serious aerodynamic heating problems become an unavoidable key issue in the design of a hypersonic inlet. This needs to take into account both aerodynamic performance and heating of a hypersonic inlet, which are actually dependent on local flow characteristics. Consequently, it is of great importance to study flow characteristics on typical parts of a hypersonic inlet subjected to severe aeroheating for the engineering application and development of basic subject. It is well recognized that flight condition can largely affect the interference between the external waves and a bow shock in front of a cowl lip, thus resulting totally different heating rates distributions in hypersonic inlet. However the effect of incoming flow condition on aerodynamic heating of cowl lip and inlet were not thoroughly studied and a clear conclusion was never drawn for engineering application. It is may be due to the fact that the complicated flow conditions are difficult to simulate and results at given inlet design may not easy to explain. However engineers still want to get a rule between incoming flow conditions and heating rates of hypersonic inlet. In this paper, study of flow characteristics and aerodynamic heating for the full size hypersonic inlet module were conducted in the JF-12 wind tunnel which can duplicate hypersonic flight conditions. Numerical simulation were also investigated in order to review the aerodynamic heating performance and connection rules between inlet heating and flow conditions. Both ground test and simulation results showed the heat flux of 5-10MW/m2 on the inlet due to the complex shock wave structure.The obtained results can provide direct information in inlet and mission design.