Numerical Simulation of Aerodynamic Heating Reduction due to Opposing Jet in Supersonic Flow

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Abstract

In supersonic flight, severe aerodynamic heating takes place at the nose of blunt body and causes ablation. Accurate prediction of aerodynamic heating and construction of proper thermal protection system are required. The numerical study on a reduction of aerodynamic heating by opposing jet has been conducted. Flow field around a hemisphere model is calculated in supersonic free stream of Mach number 3.98 and the coolant gas is injected through the nozzle at the nose the model. CFD method was Finite Volume Method for time integration be used, axisymmetric full Navier-Stokes equations were applied as governing equations and $k-\epsilon$ turbulence model is used. Numerical simulation demonstrated. compared with no jet, the reduction of aerodynamic heating due to opposing jet was to be proved quite effective at the nose of blunt body. Parameters in this numerical study insofar, as the pressure ratio is increased, caused the wall pressure and heat flux decrease, and recirculation region size largen. effective reduction of the aerodynamic heating remarkably. As the opposing nozzle diameter ratio was decreased, the pressure and heat flux increased, and recirculation region size lessening, the effect of reduction aerodynamic heating was reduced.

Figure: The schematic diagram of flow field

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