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EXPERIMENTAL INVESTIGATION ON DRAG REDUCTION BY PLASMA COUNTERFLOW JETS IN MACH 7 SHOCK TUNNEL

Abstract

Various studies have been attempted to reduce the drag acting on high-speed vehicle. At the blunt shaped head of the high-speed vehicle, bow shock waves are generated, and the counterflow jets causes the position of the shock wave to move away from the body. The structure of the flow field deformed by the counterflow jets results in drag reduction. There are many variables in the counterflow jets that affect drag reduction. In this study, the condition of the freestream is the same, and the plasma is injected as counterflow jets for the study according to the injection condition. If the shape of model is same, the structure of the flow field and the drag reduction effect are different depending on the injection pressure in general. Counterflow jets system using only gas can easily regulate the injection pressure by a regulator. The plasma generator generates a plasma in the chamber at a suitable pressure and power. It is necessary to satisfy an environment in which plasma can be generated by discharging together with proper fluid supply. The objective of this research is to conduct an experiment using a Mach 7 shock tunnel to analyze the drag reduction characteristics with and without plasma. In the shock tunnel, the test section must satisfy the pressure condition of 100 pa to devolop a suitable freestream. Since the environment in which the plasma is discharged differs from the atmospheric pressure, proper insulation is required inside the test section. The counterflow jets, which is operated in the test environment, confirms the drag reduction effect by visualization system and axial force measurement. The flow structure is directly related to the drag reduction effect, so it was observed by constructing the Schlieren system using the high speed camera. Similar to previous research results, when the injection pressure increases, the position of the shock wave is moved away from the body. The measured force requires data processing through dynamic calibration. The calibrated data can be compared as a result of quantitative reduction.