Abstract Submitted
for the DFD12 Meeting of
The American Physical Society

Numerical simulation of supersonic water vapor jet impinging on a flat plate KAZUTO KUZUU, Japan Aerospace Exploration Agency (JAXA), JUNYA AONO, Research Center of Computational Mechanics, Inc., EIJI SHIMA, Japan Aerospace Exploration Agency (JAXA) — We investigated supersonic water vapor jet impinging on a flat plate through numerical simulation. This simulation is for estimating heating effect of a reusable sounding rocket during vertical landing. The jet from the rocket bottom is supersonic, M=2 to 3, high temperature, T=2000K, and over-expanded. Atmospheric condition is a stationary standard air. The simulation is base on the full Navier-Stokes equations, and the flow is numerically solved by an unstructured compressible flow solver, in-house code LS-FLOW-RG. In this solver, the transport properties of muti-species gas and mass conservation equations of those species are considered. We employed DDES method as a turbulence model. For verification and validation, we also carried out a simulation under the condition of air, and compared with the experimental data. Agreement between our results and the experimental data are satisfactory. Through this simulation, we calculated the flow under some exit pressure conditions, and discuss the effects of pressure ratio on flow structures, heat transfer and so on. Furthermore, we also investigated diffusion effects of water vapor, and we confirmed that these phenomena are generated by the interaction of atmospheric air and affects the heat transfer to the surrounding environment.

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Date submitted: 31 Jul 2012 Electronic form version 1.4