Numerical simulation on shock-induced combustion of premixed hydrogen-oxygen mixtures

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Shock-induced combustion of premixed hydrogen-air with equivalent ratio around hypervelocity conical projectile and oblique wedge was numerically investigated using Finite-Volume Navier-Stokes（N-S） equations considering chemical reaction with a variation in free-stream conditions and projectile diameter. The numerical methods used here are the second order time accurate Steger-Warming flux Jacobian splitting with LU-SGS implicit iteration. The chemical reaction source is diagonalized implicitly. The hydrogen-air chemistry mechanism is seven species and eight step mechanism. As a first step of validation procedure, simulation of Lrhr's experimental results were carried out to confirm the reliability of the method mentioned above, including the examination of the appropriateness of grid by grid refinement study.

Next, the section presents the results of hypersonic blunt body flows and of a three-dimensional ODW configuration. the effect of the projectile flight Mach number(M=4.18, 5.11, 6.46) on the hydrogen-air combustion flow field structure are tested. Results show that, the grid refinement is necessary for the simulation of the appropriate flow structure, the combustion field becomes stable with increasing projectile Mach number.

As a final step, the section presents the results of hypersonic flow of a three-dimensional oblique detonation wave (ODW) configuration. The results show that, the triple wave point lies at the location close to the experimental result.

Keywords: Projectile; Shock; Induction; Combustion; Numerical simulation

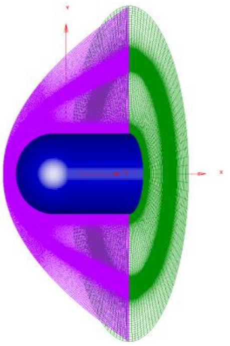

Fig.1 Adaptive grid used for Mach 6.46

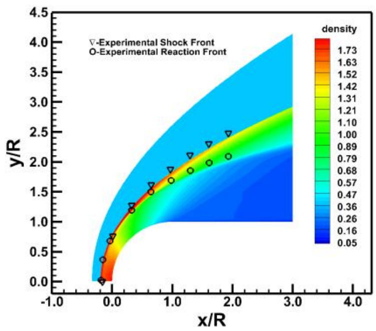

Fig.2 Density contours for Mach 6.46 with adaptive mesh

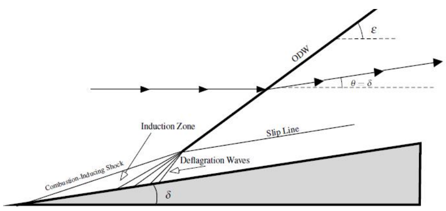

Fig.3 Simulation parameters schematic of an ODW

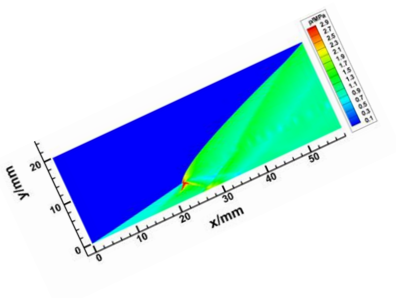

Fig.4 Pressure contours for the ODW