力学学报 2007 39 (3(中文)): 343-349 ISSN: 0567-7718 CN: 11-2063/O3

论文

激波管双爆轰驱动段性能的数值模拟研究

李进平[1];姜宗林[2];陈宏[2];冯珩[2];俞鸿儒[1]

中国科学院力学研究所高温气动重点实验室，100080[1]

中国科学院力学研究所高温气体动力学重点实验室,100080[2]

收稿日期 2005-9-5 修回日期 2006-8-2 网络版发布日期 2007-5-15 接受日期

摘要 采用频散可控的耗散格式(DCD)，求解Euler方程和一种改进的二阶段化学反应模型，对氢氧反向-正向双爆轰驱动段激波管进行了数值模拟. 计算结果表明：当辅驱动段与主驱动段初始压力比小于临界值时，Taylor波仍会出现，但波扇夹角较单一前向爆轰驱动段小，入射激波马赫数衰减率变小；当初始压力比等于临界值时，主驱动段中的Taylor波完全被消除，入射激波马赫数不再衰减. 当初始压力比大于临界值时，在主驱动段中能产生过驱动爆轰波，不仅Taylor波被完全消除，而且驱动能力较单一前向爆轰驱动段强.

关键词 爆轰波 双爆轰驱动段 激波管 Taylor波

分类号 0354.5

Numerical study on backward-forward double-detonation driver for high enthalpy shock tubes

Jinping Li Zonglin Jiang Hong Chen Heng Feng Hongru Yu

Abstract

A numerical investigation on the performance of a backward-forward double-detonation driver for high enthalpy shock tubes was conducted by solving one-dimensional Euler equations with the Dispersion Controlled Dissipative (DCD) scheme. The modified two-step chemical reaction model was applied to describe chemical reactions of the oxygen-hydrogen mixture. The numerical results indicate that if the initial pressure ratio of the auxiliary driver section to the primary driver section is less than the critical value as was estimated under the condition of no Taylor expansion waves in the driver, Taylor expansion wave is still observable with a smaller angle of the expansion wave fan; if the initial pressure ratio is set to be equal to the critical value, Taylor expansion waves disappear and the incident shock wave does not attenuate in the driven section; if the initial pressure ratio is taken to be larger than the critical value, not only Taylor expansion waves disappear, but also an over-driven detonation wave develops in the detonation driver and can increase further the driving pressure.

Key words detonation double detonation driver shock tube Taylor waves

DOI:

通讯作者 李进平 jinping.li@tom.com