

传递现象

等温反应湍流流动标量关联量输运的直接模拟

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摘要 用谱方法对等温反应槽道湍流流动中标量关联量输运进行了三维直接模拟。所得到的无反应情况下的单标量时均值和脉动值与文献中差分法的直接模拟(DNS)数据一致。瞬态模拟结果显示有反应情况下标量脉动量也有条带结构。用直接模拟数据库对标量关联量输运方程各项的贡献进行了先验性统计,发现产生项和耗散项的贡献最大,扩散项和反应项的贡献很小,然而化学反应对各项的大小和分布规律影响很大。对标量关联量方程RANS模拟各项的封闭模型进行了后验性检验。与DNS的统计值相比,除了近壁区之外,在流场的大部分区域,模拟值与精确的统计值基本一致。

关键词 [直接模拟](#); [等温反应流动](#); [脉动关联量](#)

分类号

DNS of scalar correlation-moment transport in isothermal turbulent reacting flows

Abstract

The 3-D direct numerical simulation (DNS) of scalar correlation-moment transport in isothermal turbulent reacting flows was carried out by using a spectral method. The obtained statistically averaged and root-mean square (RMS) values of concentration for a single species in non-reacting flows are in good agreement with those obtained by using a finite-difference method reported in references. The instantaneous results show the existence of strip structures of concentration fluctuation for reacting flows. The DNS statistical results give the budget of the concentration correlation-moment equation, showing that the contribution of production and dissipation terms is important whereas the contribution of diffusion and reaction terms is small. However, the effect of chemical reaction on the magnitude and distribution of each term is important. The DNS statistical data are used to validate the closure models in the correlation-moment equation of Reynolds-averaged Navier-Stokes (RANS) modeling. It is found that generally the simulated values are in agreement with the DNS data in most flow regions, except in the near-wall region.

Key words [direct numerical simulation](#); [isothermal reacting flows](#); [scalar correlation-moment](#)

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