流动与传递

Two-dimensional Simulation for Hydrogen/Air Combustion in a Monolith Reactor

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摘要 Recent studies on hydrogen combustion were reviewed briefly. The laminar flow and combustion of premixed hydrogen/air mixture in a cylindrical channel of a monolith reactor with and without catalytic wall was numerically modeled by solving two-dimensional (2-D) Navier Stokes (N S) equations, energy equation, and species equations. Eight gas species and twenty reversible gas reactions were considered. The control volume technique and the SIMPLE algorithm were used to solve the partial differential equations. The streamlines of the flow field, temperature contours, the entrance length, and the concentration fields were computed. It is found that the entrance zone plays an important role on flow and temperature as well as species distribution. Therefore, the flow cannot be assumed either as fully developed or as plug flow. There is a small but strong thermal expansion zone between the wall and the entrance. Both diffusion and convection affect the heat and mass transfer processes in the expansion zone. Thus the equations of momentum, energy and species conservations should be used to describe hydrogen/air combustion in the monolith reactor. The hot-spot location and concentration field of the homogeneous combustion is strongly influenced by the inlet velocity and temperature, and the equivalence ratio. The catalytic combustion of premixed hydrogen/air mixture over platinum catalyst-coated wall in a cylindrical channel was also simulated.

关键词 micro-reactor,monolith,combustion,catalysis,hydrogen,simulation

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