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NUMERICAL SIMULATION OF ARC-HEATED NON-IDEAL ELECTROMAGNETIC FLUID TRANS-SUPERSONIC FLOW BY NND SPATIAL DISCRETIZATION SCHEME

Abstract

To develop numerical simulation technique of electromagnetic fluid flow and reveal arc-heated electromagnetic fluid flow mechanism, unsteady numerical simulation of representative arc-heated non-ideal electromagnetic fluid trans-supersonic flow was performed by using a time marching method associated with NND special discretization scheme. Most physical mechanisms of general electromagnetic fluid flow, such as trans-supersonic flow, large expansion, viscous effect, electricity energy introduction, interaction between electric fluid and magnetic field, heat transfer and nonequilibrium dissociation and ionization reaction, were taken into account in the physical model. Navier-Stokes equations were extended with electromagnetic and chemical source items, fully-coupled with species continuum equations and semi-coupled with Maxwell's equations to characterize the physical model mathematically. The control equations were solved by using a time marching method associated with convective NND special discretization scheme. The results of present investigation show that the time marching method associated with NND special discretization scheme can be used to simulate arc-heated non-ideal electromagnetic fluid trans-supersonic flow effectively, and the present numerical simulation reveals detailed physical mechanisms of this kind of electromagnetic fluid flow.