Investigation of thermal condition of model channel of a complex shape at the supersonic flow of a multicomponent radiating and reacting gas mixture

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In the present paper, the problem of determining the thermal state of a complex shape channel under the flow of a high-speed reacting flow in it is considered. A reliable determination of the flow path walls thermal state becomes possible when solving the coupled heat transfer problem. As the object of investigation, a channel of variable cross-section was chosen. Outside, the channel is cooled by hydrogen in a supercritical state. The walls of the channel on the outer side are smooth. The study is mainly aimed at determining the proportion of radiant heat flow, its effect on the overall thermal state under different flow regimes in the channel, including thermal locking. The problem was considered in a two-dimensional formulation for different values of the mass flow of hydrogen. In this case, a complete Favre averaged system of Navier–Stokes equations for nonstationary turbulent reacting flows was solved with closure using the one-parameter model of Spalart–Almaras turbulence. The thermophysical properties of hydrogen in the supercritical state were described using polynomial dependencies.