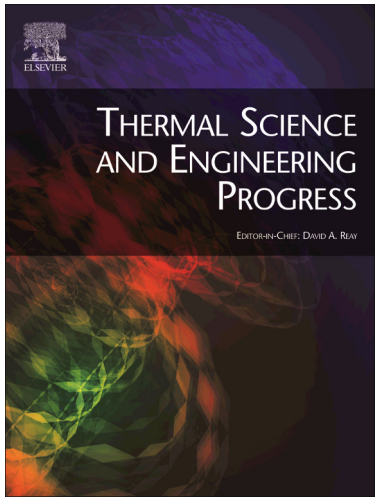

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A novel method for analysing the thermal behaviour of charring ablator

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Abstract

Full comprehension of the thermal behavior of the charring ablator is of great importance in designing the thermal protection system (TPS) of a reentry vehicle. To analyze the thermal response of the charring composites under aerodynamic heating, we have improved one-dimensional coupled pyrolysis layer model, in which the transfer of the heat and mass, the moving interfaces and the ablation surface are coupled. A new iterative method is proposed to determine the moving distances of the two moving interfaces and the ablation surface in each time step. The implicit finite difference formulas are derived from the governing equations, and programmed in MATLAB. The iterative method is validated with the arcjet test data in NASA Ames Research Center, and then the thermal response of the phenolic impregnated carbon ablator (PICA) in the Orion vehicle during a lunar return is predicted. This study will be helpful for the optimization of the TPS in reentry vehicles.

Keywords: Iterative method; Thermal behavior; Charring ablator; Coupled pyrolysis layer model