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THERMAL DECOMPOSITION OF MODEL ENDOTHERMIC HYDROCARBON FUELS AND THEIR MIXTURES

Abstract

When hypersonic vehicle is flying near space, one of the most important challenges is the exposure of some aircraft components to extremely high aerothermal loads. Under this environment, classical materials like metals or simple ceramics can no longer be used because of thermal and structural failures. Regenerative cooling using hydrocarbon fuel on board has been considered to be the most effective and practical solution. This paper addressed the key scientific issue about thermal cracking behavior of model compounds of endothermic hydrocarbon fuel and their mixtures in the regenerative cooling channel. Thermal decompositions of model compound and a serials of mixtures with 50/50 ratio were performed in an electrically heated tube under practical high temperature/pressure conditions (750 oC, 3.5 MPa), including n-decane, n-dodecane, n-tetradecane, isooctane, n-propylbenzene, decahydronaphthalene, methylcyclohexane. It was found that: 1) n-tetradecane yields highest cracking conversion among model compounds at the same operation condition, and generates a higher olefins/paraffins ratio in gaseous product than isooctane, n-propylbenzene, decahydronaphthalene and methylcyclohexane; 2) isooctane has an accelerating effect on the pyrolysis of n-dodecane, while n-propylbenzene, decahydronaphthalene and methylcyclohexane inhibit the pyrolysis of n-dodecane; 3) isooctane has an accelerating effect on the cracking conversions of n-propylbenzene, decahydronaphthalene, methylcyclohexane owing to possible effect on the radical generation mechanism; 4) decahydronaphthalene shows a inhibiting effect on the cracking of methylcyclohexane, while methylcyclohexane inhibits the pyrolysis of decahydronaphthalene. The result plays an important role in the composition design of advanced endothermic fuel.