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ESTIMATION OF EPDM INSULATION ABLATION CONSIDERING VARIABLE PROPERTIES

Abstract

Due to the bad internal thermal environment of solid rocket motor, the thermal protection problem has always been one of the key issues in related fields. EPDM(ethylene propylene diene monomer rubber) insulation materials, because of its good ablation thermal protection performance, are popular in the field of solid engine thermal protection. Its ablation is a dynamic process accompanied by a series of physical and chemical reactions, inevitably along with the continuous change of various physical parameters, that's why the ablation model considering physical property change of insulation ablation forecast has positive significance. In this paper, based on the physical parameters varying with temperature obtained from the experiment, a ablation model of EPDM insulation with variable physical properties was proposed and the prediction was realized. The differential scanning calorimetry(DSC) and thermogravimetric analysis(TG) experiments of EPDM at different heating rates were carried out, obtained the original layer insulation and time-varying relationship. The variation of thermal conductivity of carbonized layer and original layer with temperature was measured by testing equipment for independent intellectual property rights which is already been proved to be precise. Subsequently, the variation of density, thermal conductivity and specific heat at constant pressure of pyrolysis layer of insulation material with temperature was fitted. A variable physical heat conduction model was established based on the EPDM three-layer ablation model, and a coupled ablation calculation model was established considering the real gas environment of the engine. And then programmatically using the established model of EPDM insulation blanket ablation process is simulated, and compares with the relevant experimental data, the ablation rate error is less than 8