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ANALYSIS ON ABLATION MECHANISM OF IRONY METEORITE UNDER ARC HEATER TEST CONDITIONS

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ABSTRACT

Asteroids enter the Earth's atmosphere at a very high speed. Under the severe aerodynamic and radiation heating, the surface temperature of asteroids rises, and the surface materials will melt away. It is of great significance for the ground risk assessment to study the ablation mechanism of irony asteroids at hypervelocity in atmosphere and predict its ablation situation. An ablation experiment of blunt cone model with irony meteorite was carried out at arc heater of CARDC. Based on the experiment, the shear ablation model of molten layer is established to modeling ablation of irony meteoroid entering atmosphere at hypervelocity. Because asteroids usually have short flight time during entry to atmosphere, the surface heat flux only affects the thermal response of local thickness, and has not yet penetrated into the interior of flying body. Taking these factors into account, the coupling solution procedure of aerodynamic heating, ablation and internal heat conduction with moving boundary is established. Computation of the ablation experiment mentioned above are carried out and the computational results are qualitatively in good agreement with the test results. The ablation rate increases as heat flux of stagnation point increases or total pressure decreases. If flowing loss of liquid layer is not considered, the variation law obtained by calculation is contrary to that obtained by experiment. Both of calculation in this paper and experiment at CARDC in 2021 reveal that ablation of irony meteoroid is dominated by shear loss of melting liquid layer. In this paper, there are some quantitative deviations between the calculation analysis and experiment, the possible reason is that the thermal physical parameters of irony meteorites are not accurate enough.