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Author: Dr. Tetsuya Yamada
ISAS&JSPEC/JAXA, Japan, yamada.tetsuya@jaxa.jp

POST-FLIGHT ANALYSIS OF THE RECOVERED HAYABUSA HEATSHIELD AND RESULTS FROM AIRBORNE OBSERVATION

Abstract

Hayabusa sample return capsule (SRC), separated from the mother spacecraft, entered the earth atmosphere over the desert of the Australia on June 13, 2010, and landed safe on the ground after passing through the excessively high aerodynamic heat load with about 14 MW/m2. All the component modules of the SRC have been recovered by June 15. The present paper overviews the reentry operation and flight of the SRC together with post-flight analysis of the recovered heatshields together with the some results taken from the airborne radiation observation during the reentry.The post-flight analysis program is planned by 3 steps and is under progress : The first step is reconstruction of the reentry flight trajectory and the flight environment. The reentry trajectory is to be reproduced synthetically taking account of the accuracy of the reentry orbit determination, the SRC landing point, atmospheric density and the wind on the reentry day. And the second step is to overview the SRC through non-intrusive method such as X-ray CT-scanning. The linear absorption coefficient (LAC) distribution over the ablator material were successfully measured and converted to the density distribution based on careful correlation between X-ray CT scanning of the recovered heatshield and arc-heated test pieces. The 3-dimensional laser-scanning has been also carried out for measuring the surface recession. Regardless of difficulty in the surface roughness, emissivity dispersion etc., 3-D surface has been numerically reconstructed and compared with the CAD data at the pre-flight. According to the airborne observation by JAXA 4-camera spectroscopic thermometry onboard DC-8, the surface temperature during the reentry was estimated to be 3400 K at maximum. The paper expands its discussion to the design validity of the thermal protection system of the Hayabusa SRC based on the results of the above post-flight analysis.