Paper ID: 25423
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SPACE EXPLORATION SYMPOSIUM (A3)
Small Bodies Missions and Technologies (4)

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DESIGN REVIEW OF HAYABUSA-2 REENTRY CAPSULE AND FURTHER TECHNOLOGY DEVELOPMENT FOR FUTURE MISSONS

Abstract

The objectives of the Hayabusa-2 mission is to explore the C-type asteroid 1999JU3 and to take back the asteroid sample which is considered to contain plenty of organic substances. Hayabusa-2 spacecraft is planned to be launched in 2014 and return in 2020. Hayabusa-2 sample return capsule (SRC) is designed to deliver the asteroid sample to the earth passing through the excessively severe aerodynamic heating environment at entry velocity of 12 km/s. As is known, Hayabusa-1 SRC successively returned to the earth in 2010, and post flight analyses were carried out for the sake of the Hayabusa-2 and future reentry missions. The present paper in the former half describes design review and verification tests of the Hayabusa-2. Hayabusa-2 SRC enters earth atmosphere and deploys the parachute at a given altitude after passing through the aerodynamic heating corridor. Hayabusa-2 SRC is required to have much more system reliability within almost same weight resource as of the Hayabusa-1 SRC. During over 10 years since the development of the Hayabusa-1 SRC, though some components have become out of manufacture line, the systems of the Hayabusa-2 SRC were designed to accomplish all the functions described above and several verification tests have been carried out; Separation mechanism from the mothership has been improved to diminish separation errors and the verification tests are carried out. Heatshield design was reconfirmed based on the post flight analysis of the Hayabusa-1 SRC and results of the heating tests of the heatshield material manufactured according to the prescribed process. As for the descending system, the functional safety of the parachute is confirmed taking account of the material long-term decay in the space environment during the orbital flight. The lessons learned through the recovery of the Hayabusa-1 and design review and verification tests of Hayabusa-2 SRC have clarified the heritage to be succeeded to the future missions and limitations and issues simultaneously. In order to realize future reentry missions such as comet sample return missions which require us of much higher entry speed reentry up to 15 km/s after long mission time of 10 years, technology development of small capsule for small body exploration are discussed partly as an extension the Hayabusa SRC technology and partly as a new technology development in the latter half of the paper.