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RESEARCH DEVELOPMENT OF THERMAL PROTECTION MATERIAL IN HIGH ENTHALPY
THERMAL ENVIRONMENT FOR LUNAR RETURN REENTRY

Abstract

The aero-thermal dynamic environment of reentry earth from lunar is very harsh, and the capsule has to endure high enthalpy and high heat-flux. The thermal protection system not only has good thermal insulation capability to protect the astronaut inside capsule, but also must have excellent ablation capability to make sure the capsule structure safe. So the ablation performance of thermal protection material (TPM) is very important in high enthalpy environment. The Apollo project of USA has successful experience of lunar landing and returning earth. The research of TPM ablation performance in Apollo project is exhaustive and representative. The "Lunar Exploration" (LE) project of China has been in its third stage. In 2014 November, the successful reentry of "ChangE" capsule is a good base for future LE project. In this paper, the Apollo project research production of thermal protection system in high enthalpy thermal environment is introduced briefly. On the other side, the development of TPM research in LE project is shown also, which include ablation mechanism, numerical simulation and ground test. Based on the two lunar projects, the research results show that the ablation performance of TPM is affected acutely by flow enthalpy. Based on the two lunar projects, the research results show that the ablation performance of TPM is affected acutely by flow enthalpy. In the condition of the unchangeable heat flux, the heat efficiency of TPM would be larger with flow enthalpy increasing, and the recession rate of TPM would be smaller with flow enthalpy increasing.