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Science Results from Ground Based Research (4)

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THE DEVELOPMENT STATUS AND TREND ANALYSIS OF SPACE MATERIAL SCIENCE RESEARCH IN CHINA

Abstract

Space materials science research has been conducted in China for more than 3 decades. The satellites and manned space program provide excellent platforms for the research of space materials. The primary purpose for the space materials study is to understand the physical and chemical processes involved in materials growth and to improve the materials processing both in space and on the ground. In 1987, materials scientific experiments was conducted in space utilizing FSW(Fanhui Shi Weixing) recoverable capsules. Lately, materials science experiments were conducted in Shenzhou spacecrafts, including Shenzhou-2, Shenzhou-3 and Shenzhou-7, and materials samples were recovered by Chinese astronauts. It was reported that more than forty space materials experiments were conducted before Shijian-10(SJ-10), including crystal growth, the melting and solidification of alloys, and material infiltration. The service performances of materials exposed in space was also tested aboard Shenzhou-7. In 2016, China successfully launched Tiangong-2(TG-2) and Shijian-10(SJ-10), both of which loaded with materials research equipments. The materials science projects in SJ-10 focused on three topics: 1) high-quality ternary alloy semiconductor crystal growth; 2) metal alloy solidification, defect control and interface phenomena; 3) melt infiltration and synthesis of composite metal matrix. Except for the topics of materials studies on SJ-10, the TG-2 also studied the assembly of nanocomposites under microgravity. The chosen materials for investigations in both SJ-10 and TG-2 are "heroic materials" for industries or science. The experiments are all one-off due to the flight features. Chinese space station(CSS) will be launched around 2022, when there will be more opportunities for materials investigations. In general, the research scientific topics for materials experiments are still to study the kinetics and physical laws of materials growth under microgravity, and to grow high-value materials etc.. Two racks of High Temperature Furnace Rack and Container-Less Rack are designed for materials experiments. The improvement of playload techniques provide better conditions for materials crystallization, and perfect environments for studying materials undercooling as well as measuring thermal physical properties. In addition, the exposed platform aboard CSS provides opportunities for performance studies of space function materials and intelligence materials. The CSS will operate in space for more than ten years and astronauts or experts can remain in the capsule for long period, therefore, the plan for materials experiments should change to achieve more. In choosing materials for study, new principles and focused materials should be considered.