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STUDY ON A NEW TYPE OF SPACE DEBRIS PROTECTION STRUCTURE FOR SPACE STATION BASED ON GRADED WAVE IMPEDANCE MATERIALS

Abstract

Space debris has become a prominent factor that threatening the safety of spacecraft, especially for the manned spacecraft such as space station. Therefore, the International Space Station has been fully designed against the space debris, mainly with advanced Whipple shield structure that stuffed with Nextel ceramic fibers. More than 20 years of the orbital operation of the ISS has proved the effectiveness of this protective measure. With the human space activities becoming increasingly frequent, the space debris environment is becoming worse, seeking new protection materials and structures against the impact of the space debris that are lighter and more efficient is one of the key technologies and hot issues to ensure the success of the low orbit manned spacecraft mission. In this paper, aimed at a new concept of graded wave impedance materials and the protective structure with graded wave impedance materials as damping screen that we have already put forward, through the optimal selection of metallic materials: stainless steel, titanium alloy, aluminum alloy, magnesium alloy and ceramic materials: aluminum oxide and silicon carbide, the combination of materials with optimal protection performance has been obtained, and the regularity of the graded wave impedance distribution influence on the properties of its resistance to impact has been studied, and the hypervelocity impact performance of the graded wave impedance materials has been evaluated from three aspects: theory, numerical simulation and experiment. As results show, in the condition of the same surface density, the protective performance of the new concept of protection structure is improved by more than 30