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SIMULATION ANALYSIS AND EXPERIMENTAL STUDY ON THE DAMAGE CHARACTERISTICS OF SOLAR ARRAYS IMPACTED BY SPACE DEBRIS

Abstract

The number of space debris increases geometrically with the decrease of its size. The collisions between in-orbit spacecraft and micron-level space debris have almost become an inevitable event. When space debris with high speed hit the spacecraft's external equipment such as solar arrays, it will affect the attitude of the spacecraft. Small impacts will lead to problems such as the waste of fuel needed for spacecraft's attitude adjustment. Moreover, the impact will also cause the solar arrays to produce temporary or permanent short circuit, and often produces high-density plasma, which induces the solar cell discharge. It even affects the spacecraft's life and the completion of space missions. Therefore, it is necessary to study the damage of solar array under impact. The simulation analysis of high-speed space debris impinging on solar arrays is carried out. The damage characteristics of particles with different particle sizes and speeds to the collision of solar arrays are compared and studied. Meanwhile, the experimental research is carried out through the high-speed impact test platform to verify the accuracy of the simulation results. By comparing the damage conditions, crack expansion and vibration characteristics under different impact conditions, the impact law of different particles on the solar arrays under corresponding conditions is obtained, and the damage mechanism and vibration change trend of the solar arrays under impact are clarified. The research on damage characteristics provides a reference for the design and manufacture of solar arrays and space protection, which can effectively reduce the impact of debris impact on satellite missions. It also provides important guidance for the overall design of spacecraft power supply, and guarantee the success of the satellite mission better.