Paper ID: 77235
oral

21st IAA SYMPOSIUM ON SPACE DEBRIS (A6)
Impact-Induced Mission Effects and Risk Assessments (3)

Author: Dr. Tao Liu
China, liutao_thu@163.com

INVESTIGATION ON SHOCK HUGONIOT OF POLYIMIDE VIA ALL-ATOM MOLECULAR DYNAMICS SIMULATION

Abstract

Polyimide materials are widely utilized in the aerospace industry for their superior thermodynamic performance, making them ideal for use in insulation blankets and flexible membrane structures such as solar arrays, film antennas, and solar sails. However, these materials are susceptible to damage from hypervelocity impacts caused by micrometeoroids and orbital debris, posing a significant threat to their performance and structural integrity. This paper examines the shock characteristics of polyimide through all-atom molecular dynamics simulations using the multiscale shock technique (MSST). The study establishes the shock Hugoniot relationship of polyimide, which shows good agreement with macro-experiments, affirming the reliability and accuracy of the approach. The effects of the initial temperature and molecular chain length/number on the Hugoniot are also explored, with accompanying elaboration on the atomic mechanisms involved in polyimide shock behavior. This research aims to bridge the gap between micro-molecular dynamics and macro-level shock responses, laying the groundwork for the investigation of HVI in polymer materials.