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Hypervelocity Impacts and Protection (3)

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MICROWAVE EMISSION FROM HYPERVELOCITY IMPACTS USING ALUMINUM AND NYLON FOR TARGET AND PROJECTILE MATERIALS

Abstract

Space debris moves at 7 - 8 km/s in a low Earth orbit, and the collision can cause a significant damage. When a projectile is impacted on a target, electrical phenomena as well as structural damages are reported. Electrical phenomena indicate electromagnetic radiation, impact plasma, light emission, and potential variation of the impacted target. However, the mechanism has not been clarified. Impact experiments using a two-stage light gas gun were carried out and electrical phenomena were observed. Aluminum plates with different mechanical properties were used as targets. A nylon sphere with the diameter of 7 mm was used as a projectile. The projectile was accelerated to a velocity of 7 km/s and struck a target in an acrylic vacuum chamber. The pressure in the chamber was evacuated to several pascals. A high speed video camera with a frame ratio of 2 μs was used for monitoring a spread of a luminous cloud. The intensity of light emission was observed by using a photodetector. An impact time was defined as the rise time of the light emission. The impact plasma was measured by using plasma probes nearby the impact point. The potential variation between the chamber and the impacted target was measured. The microwave emission was measured by using antennas and receivers. Linearly polarized antennas with frequencies of 300 MHz, 2 GHz, 5.8 GHz, and 22 GHz were used. In this paper, microwave emissions from hypervelocity impacts on different aluminum targets are described. The emitted power of the microwave was estimated and the frequency characteristics were analyzed. The results suggest that the microwave emission is related to mechanical properties.