SPACE DEBRIS SYMPOSIUM (A6)
Hypervelocity Impacts and Protection (3)

Author: Dr. Tomohiro Narumi
Kyushu Institute of Technology, Japan

Prof.Dr. Yasuhiro Akahoshi
Kyushu Institute of Technology, Japan
Mr. Susumu Fujii
Kyushu Institute of Technology, Japan

A STUDY OF PLASMA ACCELERATOR USING PULSE POWER FOR HYPERVELOCITY IMPACT TEST

Abstract

A lot of hypervelocity impact facilities have been developed in the world in order to investigate damage due to space debris and meteoroid or phenomenon of interplanetary impact. However it is theoretically difficult to exceed about 8 km/s for a velocity of projectile when using like a two-stage light gas gun or a railgun. Some of facilities achieved velocity of a projectile faster than 8 km/s, however there are problems of maintenance, repeatability, cost, and so forth. Therefore a gun which can accelerate a projectile more than 10 km/s with ease is needed.

One answer is plasma gun. In this paper, we present the performance in hypervelocity impact using a plasma gun which is developed at Kyushu Institute of Technology. In the launcher, thin aluminum plate is located as a generator of plasma. Large capacitor bank (storing energy: 100 kJ, maximum charging voltage: 16 kV, capacitance: 750 mF, maximum discharge current: 500 kA) supplies pulse power to the plate, then the aluminum generates spreading plasma. The plasma banks up by a separating film made from polyester, accordingly pressurizes inside. When attaining rupturing pressure, the plasma diffuses rapidly, and the plasma is accelerated by Lorentz force and nozzle, eventually projectiles are accelerated by the plasma. Therefore it is essential to match the peak time of currents of capacitor bank and discharging for accelerating projectiles efficiently. We investigated improving ways of the matching by two means. One is to use magnetic pulse compressor for faster rising time of current from capacitor bank. The other is add partition plates in the launcher for delay of plasma diffusion. Consequently accelerated projectiles by high voltage pulse power in the launcher impact on a target material in the test chamber at around 10 km/s.

Application and experimental results will be also shown in this paper.