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PRELIMINARY STUDY OF DEVELOPMENT OF SPACE DEBRIS REMOVAL METHOD USING ELECTROSTATIC FORCE

Abstract

Debris is naturally existing fragment or undesired materials disposed from satellite which can cause damage to satellite, as for the example paint separated from satellite can collide with the artificial satellite which is going in an orbit at 10km/s average velocity can cause major damage. Although problem of space debris are discussed often, still there is no effective action plan for its removal. There are some protections such as dumber for protection against space debris. However, it is difficult to keep debris from occurring at all. The purpose of this research is to develop the removal method of space debris using plasma in the space environment. Bias the debris particle negatively and decrease the altitude by electrostatic force to the direction which decelerates the speed of debris and debris will burn during entering into atmosphere. We are focusing on the debris with diameter less than 1cm whose research has not progressed so far. Positively biased net is extended in space, and produces a negative sheath. The debris which entered into the net will be negatively charged in the negative sheath and decelerated by the electric field force. Debris decreases its altitude and is burned out byatmospheric friction.

Two Experiments were done, first is floating potential measurement experiment. In this experiment, a metal plate is arranged at center of a vacuum chamber. We investigated how the floating potential influence the probe potential placed in front of net. When net is biased positively, electrons are drawn by a metal net and a negative sheath is formed. A measurement probe which is able to move back and forth by stage is placed in front of net and the relation between applied voltage and measurement potential is verified experimentally. Second experiment is charged copper powder falling experiment. In order to achieve the purpose of this research, it is required to charge powder debris negatively. Therefore, it was checked whether the charged copper powder could be drawn near to the net by electric force. In this experiment, copper powder was used as debris. On passing through the net having positive applied voltage, the powder gets charged. Whether the orbit of powder could be change due to electrostatic forces or not was verified by this experiment.

Future task is to do charged copper powder falling experiment using high pulsed voltage, because it is difficult to keep applying high voltage to the net in space.