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INFLUENCE OF CARBON NANOTUBE ACTUATOR BY SPACE ENVIRONMENTAL FACTORS

Abstract

We are developing a carbon nanotube actuator (CNA) that is expected to be used for maintaining the shape of a large-scale antenna such as for a solar power satellite (SPS).

The SPS is a huge satellite that aims to generate electricity by using solar power in space and transmit energy to the ground using the microwave. The SPS that is considered by Japan is assumed to generate power in the 1GW class, and its size is several kilometers square. So that it is requiring large solar panels and power transmission antennas. In addition, there is a concern that the entire SPS will be thermally deformed due to the temperature differences between the surface exposed to sunlight and the opposite surface. It is necessary to control the deformation of the entire SPS so as not to lower the energy conversion efficiency and transmission efficiency due to thermal deformation.

To solve the above problem, we are studying to disperse the actuators throughout SPS and correct the shape by activating the actuators. Regarding the actuator, we are developing a CNA. CNA is a polymer actuator using carbon nanotube. And this consists of three layers with two carbon nanotube electrodes (CNT electrodes), which are composed of carbon nanotube, polymer and ionic liquid, and with a separator layer composed of polymer and ionic liquid. One of the features of CNA is that it has a simple structure of three layers, so that it has less wear during operation and can be used for a long time. In addition, because of using carbon nanotubes, the electrical conductivity of the CNA is excellent, and it can be operated with low power of several volts. Therefore, it is greatly expected to be applied to future spacecraft.

However, there are few researches on the space application of CNA, and it is not known whether it can be used in space without any problems. Therefore, we conducted to evaluation on the space environment resistance of CNA by experiments. In this paper, we will describe the results of thermal vacuum experiments, electron total dose testing and UV irradiation testing of CNAs.