19th IAA SYMPOSIUM ON VISIONS AND STRATEGIES FOR THE FUTURE (D4)
Space Elevator as Transportation Infrastructure to Access Space (3)

Author: Dr. Yoji Ishikawa
Obayashi Corporation, Japan, ishikawa.yoji@obayashi.co.jp

Mr. Yasuhiro Fuchita
Obayashi Corporation, Japan, fuchita.yasuhiro@obayashi.co.jp
Dr. Takashi Hitomi
Obayashi Corporation, Japan, hitomi.takashi@obayashi.co.jp
Prof. Yoku Inoue
Shizuoka University, Japan, inoue.yoku@shizuoka.ac.jp
Ms. Naoko Baba
Japan Manned Space Systems Corporation (JAMSS), Japan, baba.naoko@jamss.co.jp

EXPOSURE OF COATED CNT YARNS TO SPACE

Abstract

Previously, we found carbon nanotube (CNT) yarns were damaged by exposure to the space environment due to atomic oxygen attacks. In the experiment, pristine carbon nanotube (CNT) yarns were exposed to the space environment on the international space station (ISS) at low Earth orbit (LEO). Ground-based comparison tests were performed, too. Signicant deterioration of the outer surface and substantial reduction in tensile strength were found for AO irradiated CNT yarns among the ground-based comparison tests. Transmission electron microscopic observation revealed that the crystal structure of CNT was physically damaged, showing sharp graphene edges. As to the space exposure tests, quite similar damages and decrease in tensile strength were observed on the CNT yarns. We found that high kinetic energy impacts of the AO at LEO cause severe damages to carbon crystal materials. In turn, from the summer of 2019 we are conducting the second series of space exposure experiments, using COATED CNT yarns instead of the PRISTINE CNT ones of the first experiment. Two types of coating material have been examined; one is metallic one and the other silicon-type one. Metallic material has high environmental resistance in space, so it is possible to protect objects over a long period. Little outgas from such material eliminates the possibility of polluting the space environment. Its excellent coating processability facilitates the adjustment of the coating thickness and continuous coating over long cables. The high density of metal may increase the coated cable's weight; however, adjusting design conditions will allow it to be applied to the space elevators. The silicon-type material used for the experiment is the one developed to protect an artificial satellite's material. The material has a lower density than metallic ones and is excellent in both processability and flexibility. Since it has been used in space as a sheet-like exterior material for artificial satellites, the rate of its deterioration is well known. Along with the result of the present experiment, it is possible to predict the lifetime and develop a maintenance plan based on the appropriate replacement time. In this experiment, the above two types of specimens have been exposed on the ISS front and back for one or two years, respectively. The results of the detailed analysis of the recovered samples and the evaluation of the degree of damage are reported while comparing them with the previous experimental results.