MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Interactive Presentations (IP)

Author: Mr. Viacheslav Chudinov
Russian Federation, chudinovsl@mail.ru

Mr. Denis Efremov
Russian Federation, netwind@netwind.ru
Dr. Viktor Terpugov
Russian Federation, terpugov@psu.ru
Prof. Alexander Svistkov
Russian Federation, svistkov@icmm.ru
Prof. Alexey Kondyurin
The University of Sydney, Australia, kond@mailcity.com

GROUND AND STRATOSPHERIC FLIGHT TESTS ON CURING OF COMPOSITE MATERIALS IN FREE SPACE ENVIRONMENT

Abstract

Future space exploration requires a large light-weight structure for habitats, greenhouses, space bases, space factories and other constructions. A new approach enabling large-size deployable constructions in space relies on the use of the technology of polymerization of fiber-filled composites with a curable polymer matrix applied in the free space environment on Erath orbit. In orbit, the material is exposed to high vacuum, dramatic temperature changes, plasma of free space due to cosmic rays, sun irradiation and atomic oxygen (in low Earth orbit), micrometeorite fluence, electric charging and microgravitation. The development of appropriate polymer matrix composites requires an understanding of the chemical processes of polymer matrix curing under the specific free space conditions to be encountered. Ground experiments in high vacuum, plasma and ion beam implanter with liquid polymer matrix showed, that the curing process is sensitive to factors of the free space environment. The goal of the stratospheric flight experiment is an investigation of the effect of the stratospheric conditions on the uncured polymer matrix of the composite material. The unique combination of low residual pressure, high intensity UV radiation including short-wave UV component, cosmic rays and other aspects associated with solar irradiation strongly influences the chemical processes in polymeric materials. We have done the stratospheric flight experiments with uncured composites (prepreg). A balloon with payload equipped with heater, temperature/pressure/irradiation sensors, microprocessor, carrying the samples of uncured prepreg has been launched to stratosphere of 25-30 km altitude. After the flight, the samples have been tested with FTIR, gel-fraction, tensile test and DMA. The effect of cosmic radiation has been observed. The composite was successfully cured during the stratospheric flight. The study was supported by RFBR grants 12-08-00970 and 14-08-96011.