IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (A1)
Interactive Presentations - IAF/IAA SPACE LIFE SCIENCES SYMPOSIUM (IPB)

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LAB-PAYLOAD FOR BIOLOGICAL CUBESAT SATELLITE

Abstract

A strong increase in biological and medical research in microgravity has been observed from decades. Most of these research works are initially performed with the use of simulated microgravity devices (RPM, RWV) on Earth. However, the most reliable measurement results are obtained after launching the sample into space under real microgravity conditions. Very often, bio-medical experiments are carried out at the International Space Station (ISS). The latest trend is to replace works on ISS with the use autonomous nanosatellites. For this purpose, nanosatellites in the CubeSat standard are used. One of the main constructional elements of this type of satellites is the payload in which the planned bio-medical experiments are placed. In this article a lab-payload made for the first Polish bionanosatellite will be presented. The payload dimensions were in the 2U range (10x10x20 cm3). Lab-payload was equipped with dedicated lab-chips for biological experiments. All glass lab-chips enabling the cultivation of oncological cells, mouse T lymphocytes and fungi were designed, fabricated and assembled. Also a unique micro-pot made with 3D printing technology was also developed to assess seed growth in microgravity. Lab-payload was equipped with an optical detection systems with autofocus and lighting, containers with a nutrient and dosing system, heaters to ensure the correct culture temperature, as well as temperature, humidity, pressure and radiation sensors. The whole structure of the payload was placed in a special thermos for support the atmosphere and connection with the satellite base unit, what ensured control of the experiments. Very important element was the assembling of all the systems inside the lab-payload thermos to ensure safe launch to the Low Earth Orbit (LEO). It was particularly important to mount the camera with a moving focus and lighting just above the surface of the lab-chip in such a way that the system could keep 10G overload and still be the able to control the focus for taken photos. The cooperation of all elements of the lab-payload was tested using simulated microgravity (RPM). Finally, due to the waiting time for the launch of the satellite to the LEO, it was decided to conduct experiments using fungi from the Fusarium Culmorum family and cress seeds. Lab-payload was integrated with the satellite structure and in January 2022 it was launched on LEO. The results of the conducted experiments in space will be presented at the conference.