Paper ID: 48042
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IAF MICROGRAVITY SCIENCES AND PROCESSES SYMPOSIUM (A2)
Life and Microgravity Sciences on board ISS and beyond (Part II) (7)

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DESIGN AND DEVELOPMENT OF A CUBESAT PLATFORM FOR SUPPORTING HUMAN PHYSIOLOGICAL IN-VITRO STUDIES IN SPACE

Abstract

Space radiation and the effects of microgravity on the human body are still barriers to the achievement of future human exploration of space. Today, in situ biological experiments are possible through a limited number of research racks available onboard the International Space Station, posing limitations on access by the scientific community. The need for accessible and affordable representative models of the human body in representative environments was a key driver for the development of this paper. While human physiological in vitro studies have been previously reported throughout the use of biomimetic chips, the present work represents the first attempt at conducting the aforementioned analyses in small, affordable CubeSat platforms, since previous missions in such platforms inspected only bacterial experiments. This paper introduces the design, fabrication and characterization of an affordable and versatile human organoid-on-a-chip, implemented in a CubeSat platform for further study in Space environment. This microfluidic device takes advantage of microfabrication methods to control cellular microenvironment, by providing adequate in vitro biochemical and physical conditions, thus enabling efficient and productive cell-based assay development. The developed satellite unit houses the necessary hardware to run three completely independent parallel replicas of the experiment for a validation of the biological assays. The mentioned approach can potentially lead to providing the research community a low cost and time effective alternative to the ISS for research advancement in developmental biology or finding ways to prevent tissue malformations and to treat space-related diseases, e.g. in astronauts.