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Author: Mr. Lorenzo Iannascoli
Sapienza University of Rome, Italy

Prof.Dr. Augusto Nascetti
Sapienza University of Rome, Italy
Dr. Stefano Carletta
Sapienza University of Rome, Italy

ASTROBIO CUBESAT:ENABLING TECHNOLOGIES FOR ASTROBIOLOGY RESEARCH IN SPACE

Abstract

AstroBio CubeSat (ABCS) is a 3U CubeSat that will operate within the internal Van Allen belt and it should be the first attempt to conduct biochemical experiments on a nanosatellite platform and in a so extremely harsh environment. Performing astrobiology research in space is surely challenging due to limited volumes, limited access, and stressors such as ionizing radiation and lack of convection. Moreover, experiments should be performed autonomously especially on CubeSat missions. This interdisciplinary field requires also a comprehensive, integrated understanding of biological, biochemical and planetary phenomena. To meet the requirements arising from this scenario , ABCS satellite integrates several innovative technologies ranging from experiment protocol to system level. The core of ABCS payload will be a lab-on-chip device consisting of a glass substrate on which a series of lateral flow immuno-assay (LFIA) strips on nitrocellulose support are attached. LFIA strips will be functionalized with biomolecules, immobilized in specific test areas, that will be sensed by means of chemiluminescent reactions. To avoid degradation of assay chemicals these will be deposited in a non-permanent fashion in a dry form in the initial part of the strips. On-chip detection of the analytical chemiluminescent signal, that occurs at test areas, is performed by means of hydrogenated amorphous silicon photodiodes. A custom low noise front-end readout board is employed for the biasing of the photodiode array and the readout of the photocurrents signal that contains the analytical information. In addition, it allows to interface the chip with the on-board computer. To carry out experiments in a stand-alone fashion, a third electronic board, stacked over the former, hosts a set of micropumps for the rea-gents delivery across the device. Payload operation requires a pressurized environment which is ensured by an aluminum box, hermetically sealed with an indium wire gasket. The box also provides shielding capability from the environment ionizing radiation. In this work an overview of the engineering solutions employed to meet the requirements of a CubeSat application is presented.