
CHEMILUMINESCENCE-BASED BIOASSAYS FOR ASTROBIOLOGY AND SPACE MEDICINE APPLICATIONS

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Abstract

Bioassays are gaining increasing interest in space applications, especially in life science research. Nevertheless, the development of bioanalytical devices for in-flight application is not so straightforward, since they must meet several criteria (e.g. low instrumentation's weight, volume, and power consumption) and operate in an extreme environment (e.g. microgravity, large temperature variations).

A still open question regards the maintenance of crew health in long-duration space missions, since instrumentation for early diagnosis of any dysfunction is required to enable prompt medical interventions in situ. We developed an innovative biosensor based on Chemiluminescence Lateral Flow Immunoassays (CL-LFIA) for performing clinical analyses of saliva samples. The payload comprised the equipment for saliva sampling, a ready-to-use microfluidic disposable cartridge for performing the analysis and an ultrasensitive CL reader for signal acquisition. The biosensor was tested by Paolo Nespola during his VITA mission onboard the International Space Station.

One of the main objectives of the research in the field of exobiology is the identification of organic molecules characteristic of organized biological systems. Current strategies of planetary exploration are oriented toward the development of devices capable of analyzing in-situ material samples in search of these molecules. In the frame of the project PLEIADES, we developed CL-based bioanalytical assays aimed at detecting biomarkers of extinct and extant life in extraterrestrial environments. Preliminary results regarding such bioassays in lab-on-a-chip format, will be presented, in particular regarding immunoassays and functional nucleic acid-based assays exploiting peroxidase mimicking DNazymes.

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The devices, designed for space, can be very useful also in other critical situations on Earth, for example, for point-of-care testing (POCT), in emergency medicine, in cases of bioterrorism or for diagnostics in developing countries or in remote or isolated communities, such as the Antarctic and underground stations.

Acknowledgements: PLEIADES project supported by ASI

Keywords: Chemiluminescence, Space medicine, Lab, on, chip, Immunoassays, Point, of, care testing