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Next Generation LOCAD-PTS Cartridge Development

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Introduction

Future astrobiology exploration missions will require rapid, point-of-use technologies for surface science experiments and contamination monitoring. The Lab-On-a-Chip Application Development (LOCAD) team is developing operational instruments that advance spaceflight technologies to molecular-based methods. Currently, LOCAD-Portable Test System (PTS) is quantifying levels of the bacterial molecule endotoxin onboard the International Space Station. Future research and development will focus on more sensitive molecular techniques that expand the number of compounds detected to include beta-glucan from fungal cell walls.

Objectives

- Expand the number of molecules detected by LOCAD technologies.
- Obtain contamination data using instruments in a relevant astrobiology environment.

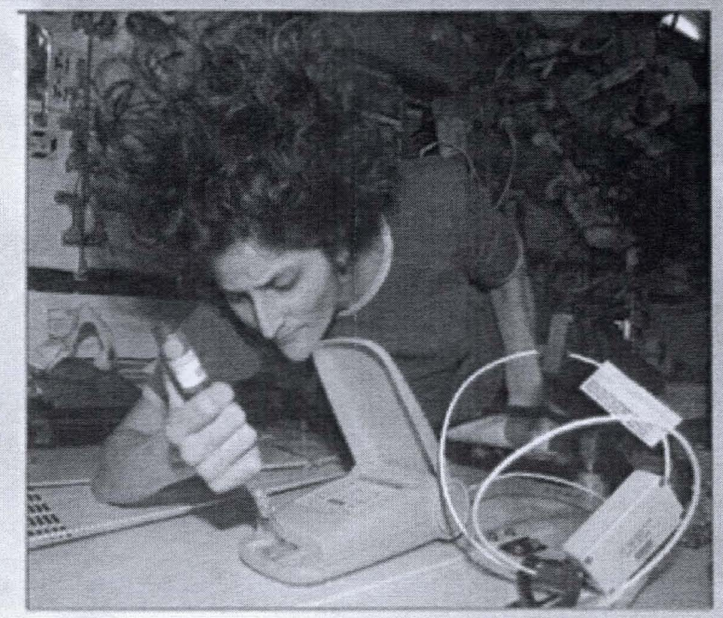


Figure 1. LOCAD-PTS operating on the International Space Station (May 2007-Feb 2008).

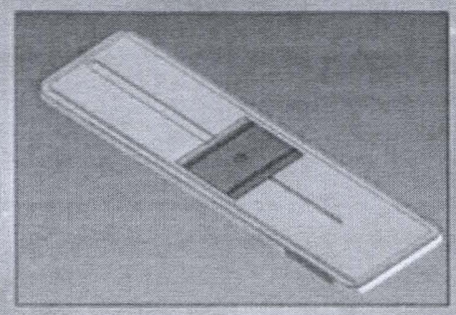
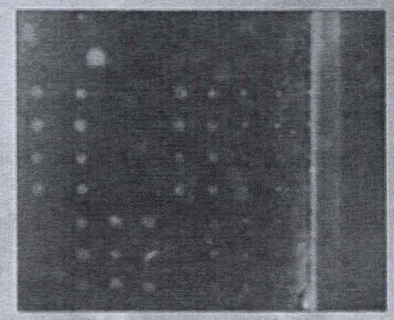


Figure 2. Modified PTS cartridge to accommodate printed microarray.

Figure 3. Protein microarray visualized with extended PTS optics.



Sample	EU/cm²	Coefficient of Variation (%)
CliffBot scoop pre-sampling	<0.002*	0.0
CliffBot scoop post-sampling	0.187	1.7
CliffBot collected sample	>0.2	0.0
Rover holder 1 pre-sampling	<0.05*	0.0
Rover holder 1 post-sampling	0.072	8.6
Rover holder 2 pre-sampling	<0.05*	0.0
Rover holder 2 post-sampling	0.112	18.8

Table 1. Endotoxin levels (EU/cm²) and standard deviation (%CoV) for surface samples taken from rovers before and after collecting a soil sample. *Sample taken after 7-step cleaning process.

Methods

- Measure change in absorbance at 395 nm over time, compare to a standard curve to determine optical units/mL of sample.
- Use sterile sample collection device, swab device surface, analyze swab for endotoxin with LOCAD-PTS.
- Label sample with fluorescent amine-reactive dye, flow over arrays, visualize array features with adjustable optics on extended PTS.

Results

- Beta-glucan can be quantified with accuracy and reproducibility using targeted detection cartridges.
- PTS endotoxin cartridge provides a sensitive technique to determine contamination levels in the field.
- Enhanced optics and the modified cartridge format allow visualization of a multi-feature protein microarray.

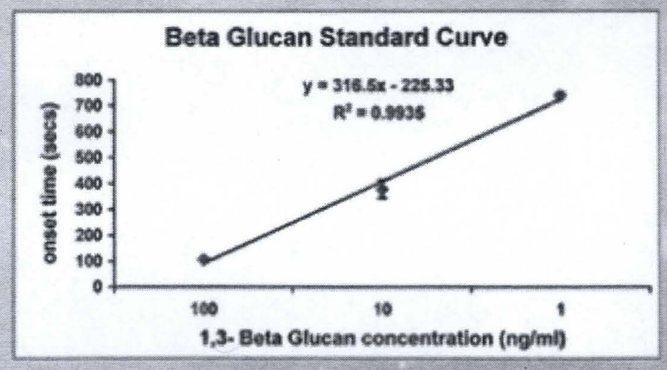


Figure 4. Data from standard curve experiments performed using the new beta-glucan detection cartridges for the LOCAD-PTS. The kinetic assay plots time to reach a transmission value of 0.94 (onset time) and beta glucan over a two log concentration range (R^2 = 0.9935).

Discussion

- New PTS cartridges expand the number of molecules that can be detected.
- Technology applicable to astrobiology research — both biomarker detection and contamination

Acknowledgments

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