Abstract

Biofilm formation has been observed on board spacecraft as well as altered bacterial behavior in different in vitro experiments, such as increased final cell counts. The formation of biofilms can decrease the efficiency and lifetime of equipment and can increase the risk of pathogen transmission. Furthermore, microorganisms in biofilms tend to have an increased resistance to disinfectants, antibiotics, and environmental stresses, and can cause human diseases and infections. In preparation for a biofilm experiment to be performed on the International Space Station where biofilm formation will be studied, different substrata materials and microbial organisms were assessed on the ground. Penicillium rubens, and Pseudomonas aeruginosa, were cultured on carbon fiber, stainless steel, aluminum 6061, titanium Ti-6Al-4V, polycarbonate, silicone, quartz and cellulose membrane coupons. The tests were performed on the same hardware planned to be used on spaceflight – BioServe’s 12-Well BioCell. Test variables included growth media, temperature and time. The data produced from this ground-based testing, presented here, will serve to inform the spaceflight experiment design.

Methods and Results

The overarching objective of this spaceflight investigation is to characterize biofilm growth during one experiment using different spaceflight-relevant microbial species and material substrata. For now, the objectives for ground control testing are as follows:

1. Characterize the growth of Pseudomonas aeruginosa and Penicillium rubens
2. Determine what media will be used for spaceflight
3. Determine the BioCell’s gas-permeable material to ensure biofilm will not form on the film

The next steps are to ensure that long-term storage conditions at 4°C does not detrimentally effect growth in media (in case of launch delays), ensuring that the media and film combinations are compatible, and designing an experimental timeline for spaceflight.

Illustration summarizing P. aeruginosa/biofilm architecture during spaceflight, (Kim et al, 2013)

Future Directions

The next steps are to ensure that long-term storage conditions at 4°C does not detrimentally effect growth in media (in case of launch delays), ensuring that the media and film combinations are compatible, and designing an experimental timeline for spaceflight.

Acknowledgments

This project is supported by NASA NNH15ZTT002N – “Research Opportunities in Materials Science - MaterialsLab Open Science Campaigns for Experiments on the International Space Station”.

References

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