Let’s Keep it clean- Assessing the efficacy of a novel antimicrobial coating after recurrent contamination of the spacecraft metal surfaces.

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Program: Spontaneous Concepts

Project Objective:

The key objective of this project is to study the efficacy of a novel antimicrobial coating after recurrent contamination of the spacecraft metal surfaces.

Background:

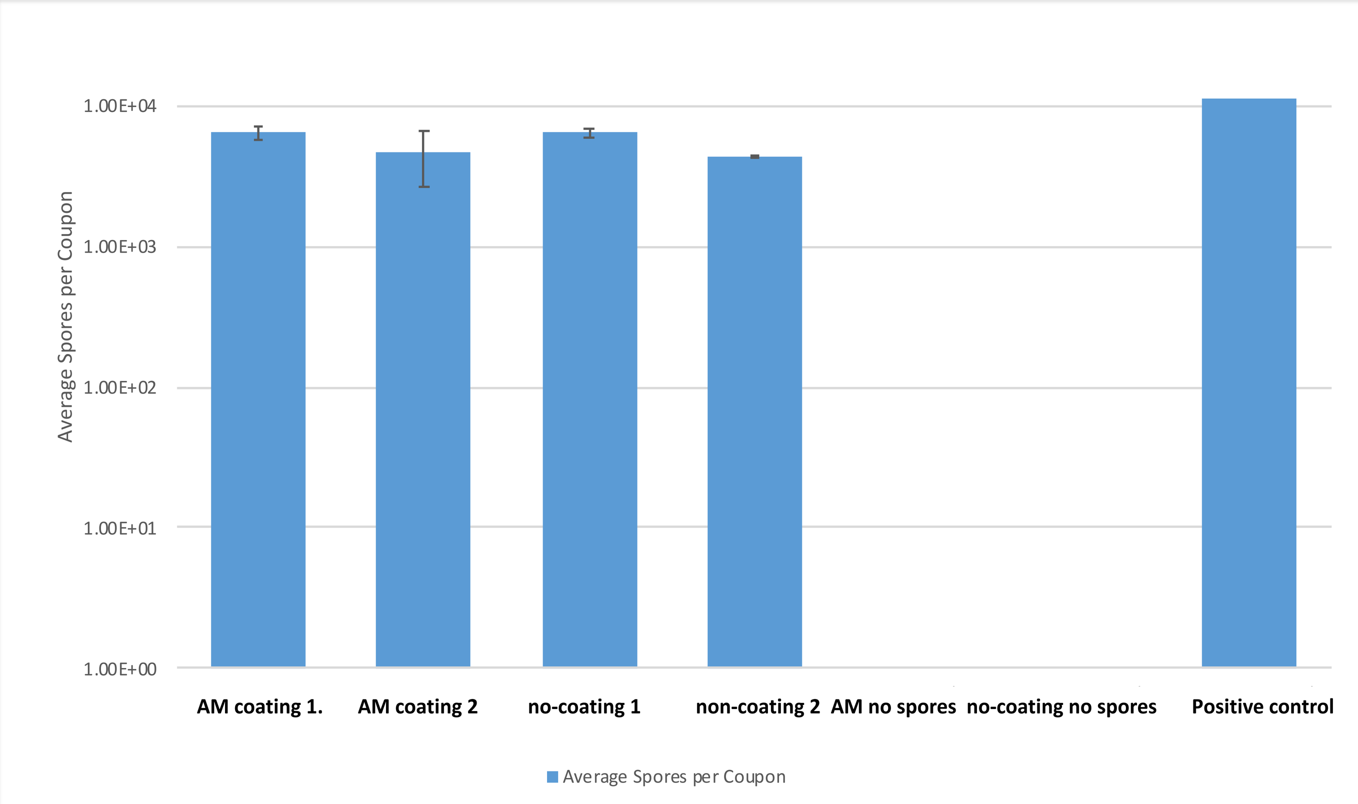
During the spacecraft assembly process, sterilization techniques are implemented to reduce the total bioburden on spacecraft surfaces to meet the Planetary Protection requirements. Unfortunately, current technologies only provide sterilization for one instant in time. Post-sterilization handling of the hardware for testing and re-work requires frequent surface cleaning, re-sterilization, and planetary protection testing, leading to substantial resources and delay during the critical assembly process. “How to keep the hardware sterile without a physical bio-barrier?” is a technical challenge for engineers and planetary protection researchers. Physical Sciences Inc. (PSI) has developed a novel antimicrobial (AM) coatings with high efficacy against bacteria, spores, fungi, and viruses. Application of PSI’s coating on the surfaces of spacecraft materials will act as a bio-barrier that will prevent inadvertent contamination throughout the spacecraft assembly, testing, re-work, and integration process.

Implementation of this novel approach would avoid time-consuming repeated sterilization and cleaning steps, a substantial reduction in overall mission cost and increase planetary protection implementation success. Results obtained from this study will lead to the development of strategies for coating spacecraft components and ground support equipment for multiple missions, such as the M2020 sample caching system (SCS), Europa.

Approach:

JPL inoculated bacterial cells/ spores on AM coated, and non-coated aluminum coupons. NASA standard spore assay and viability testing were performed to test the viability of the inoculated bacterial spores/ cells.

PSI coated the aluminum coupons (5.5 cm x 5.5 cm) provided by JPL to produce optimal AM coating levels. A staining methodology determined the AM attachment and uniformity. The coupons with optimal AM surface coverage were sent to JPL for efficacy evaluation.



Results:

No statistically significant difference in colony counts (CFU/coupon) was observed between AM coated and non-coated coupons. We repeated the experiment twice with a new set of coupons provided by PSI and did not found any significant difference. Based on the results, we can conclude that the AM coating has no anti sporicidal effect as claimed by PSI.

Significance of results:

PSI has developed a novel anti-microbial (AM) coating with high efficacy against bacteria, spores, fungi, and viruses. They got encouraging results for their AM-coating efficiency during the SBIR step I project. All the analyses were performed in the presence of a liquid media and not in dry conditions. The presence of liquid media facilitates the interaction between the anti-microbial moieties and the spores. We can not use liquid media while testing AM coating efficacy on spacecraft surfaces.
Validation assays performed during this R&TD task at JPL, we confirmed that the AM coating developed by PSI has no anti-sporicidal efficacy in dry conditions on metal surfaces.
We conveyed our findings to PSI, and they agreed with our observations. Our results contradict the SBIR funded project outcomes and alert NASA not to use this AM technology at its present form for any anti-microbial coating applications for spacecraft surfaces.

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