On the Use of Plasma Sterilization for Planetary Protection: Investigation of the Destruction of Bacterial Spores from a Laboratory Strain and a Spacecraft Assembly Isolate by a Low-Pressure VHF-CCP

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The sterility of various objects is a major demand in many fields, e.g. medicine, pharmacology, food-industry, or even for planetary protection. Since the requirements for sterilization are quite similar in the case of medicine and planetary protection, it suggests itself to apply plasma sterilization also for planetary protection.

Planetary protection has the aim to preserve the ability to study other worlds as they exist in their natural states, to avoid contamination that would obscure ability to find life elsewhere – if it exists, and to protect Earth's biosphere, in case it does [1]. Therefore, spacecrafts need to be constructed and assembled under conditions as sterile as possible. Plasma sterilization can contribute to planetary protection, since it is a very effective tool, causing different types of stress for bacteria. Furthermore, it is a sensitive and material-friendly sterilization method that can be tuned to meet specified requirements.

For the investigation of the destruction of bacterial spores we have chosen *Bacillus subtilis* 168, which is not only often used as astrobiological model system, but also widely used for various industrial applications, e.g. sterilization. In addition, spores of the spacecraft assembly facility isolate *Bacillus pumilus* SAFR-032 were investigated. The spores were deposited aseptically onto the surface of stainless steel screws, to simulate a spore-contaminated spacecraft hardware component. The screws were exposed to H_2-plasma for different treatment times (15 s, 30 s, 45 s, 60 s). Additionally, evaporated liquids were applied to obtain a two-step process to enhance decontamination efficiency.

Several experimental conditions led to full spore inactivation. The results reveal that the spore survival depends on various factors, e.g. initial spore load and strain-specific sensitivity to H_2-plasma. Spores of *B. pumilus* SAFR-032 were significantly more resistant to H_2-plasma than the laboratory strain *B. subtilis* 168 [2].

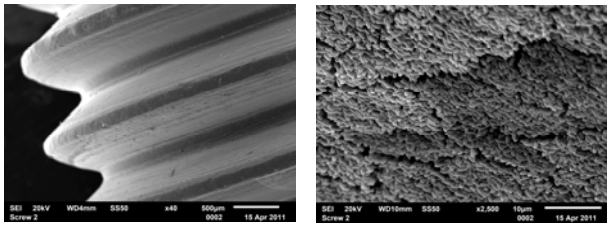

Figure 1: *SEM images of the contaminated screws*

References

[1] http://planetaryprotection.nasa.gov/about/
[2] Stapelmann, K. et al., Astrobiology 2012 (in preparation)