SPACE SYSTEMS SYMPOSIUM (D1)
Enabling Technologies for Space Systems (2)

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NON-EQUILIBRIUM ATMOSPHERIC-PRESSURE DIELECTRIC BARRIER DISCHARGE PLASMA: A TECHNOLOGY FOR ACHIEVING PLANETARY PROTECTION REQUIREMENTS

Abstract

As a solution to chemically and thermally destructive sterilization methods currently used for spacecraft, non-equilibrium atmospheric pressure Dielectric Barrier Discharge (DBD) plasma is proposed to treat surfaces inoculated with common and extremophile microorganisms. The purpose of this study is to show that non-thermal plasma has the ability to completely destroy bacteria to the DNA level on the surface of spacecraft materials without thermal degradation of the material. This is achieved by a threefold approach: physical, biological, and chemical. The physical approach involves characterizing plasma discharges in varying regimes to understand the properties of the discharge. The biological approach entails gathering evidence of reduction in bacterial load due to dielectric barrier discharge plasma treatment and understanding the sequence of events leading to a microorganism's death when exposed to plasma. Polymerase Chain Reaction, Gel Electrophoresis, florescent assays and colony counts are among the techniques needed for this facet. The chemical approach adds understanding of sterilization mechanisms via the analysis of chemical reactions caused by UV photons, ions, and other components of plasma. This facet requires, in addition to biological assays, the use of a scanning electron microscope (SEM) to determine the morphological changes of the bacteria with increased plasma dose. This threefold approach has shown that plasma succeeds in achieving complete disintegration of bacteria and alluded to the possible mechanisms. This will ultimately aide in preventing both forward contamination of planets and moons and reverse contamination of Earth for future NASA space missions.