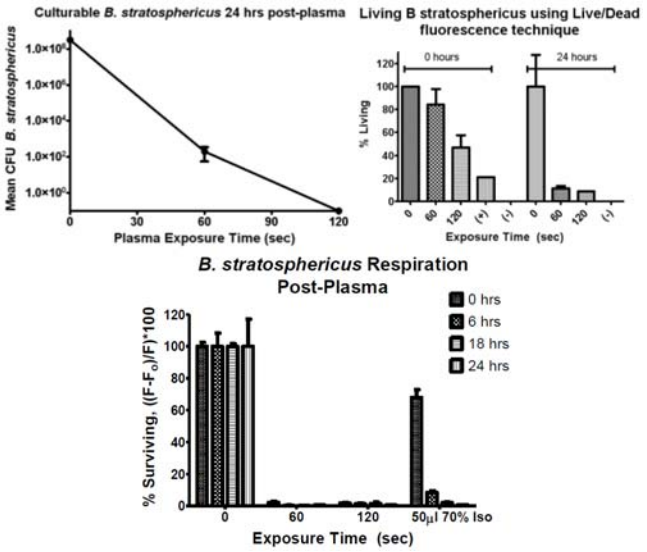
ELUCIDATION OF LEVELS OF BACTERIAL VIABILITY POST-NON-EQUILIBRIUM DIELECTRIC BARRIER DISCHARGE PLASMA TREATMENT*

Moogega Cooper, Gregory Fridman, Suresh Joshi, and Alexander Fridman
Drexel Plasma Institute, Drexel University, Philadelphia, PA 19104 USA

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 everyday and extremophile bacteria. 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.

Evidence of reduction in bacterial load due to dielectric barrier discharge plasma treatment was gathered and an understanding was gained of 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 used. Results have shown that plasma succeeds in achieving complete disintegration of bacteria and alludes to the possible mechanisms. Furthermore, using a methodology which correlates three assays, we have shown that at a sublethal dose of ~60 J/cm^2 DBD plasma is able to induce an intermediate state of existence where bacteria cease to be culturable but retain their ability to respire and maintain an intact membrane. We hypothesize that this is a viable but nonculturable (VBNC) state which plasma is able to induce and those in the plasma community may misconstrue as "dead" bacteria. The primary goal is to disseminate information about proper methods to assess viability beyond the traditional colony count method.



* Work sponsored in part by NASA grant NNH04ZSS001N.