IN SITU DETECTION OF EXTANT MICROBIAL LIFE IN EXTRATERRESTRIAL SETTINGS USING DIELECTRIC SPECTROSCOPY

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We are investigating dielectric spectroscopy (DS) as an *in situ* life-detection tool. Biologically active, JSC Mars-1 regolith simulant contains microorganisms and biomolecules equivalent to 10^6–10^7 cells/gram, less than common soils (which contain up to 10^9 cells/gram). When DS was conducted on water extracts of soil and JSC Mars-1, the dielectric constant and conductivity were higher for autoclaved samples than for untreated samples, perhaps due to lysis of cells and consequent release of charged molecules. The values obtained for unsterilized samples may be due, not only to the presence of charged molecules, but also to the membrane potentials of live cells. Thus, at 4˚C and 37˚C, we tested *E. coli* suspensions (2.5 x 10^9 cells/ml), as well as fetal bovine serum (FBS) specially treated to eliminate all known or suspected life forms, including the controversial nanobacteria. At 10 Hz, the dielectric constant for an *E. coli* suspension at 37˚C was 70% higher than that at 4˚C. The dielectric constant for sterile FBS increases by only 6.5% for the FBS at 37ºC vs. 4ºC. To establish a standard for comparing samples containing organic biosignatures of either kind –extant or macromolecules only– we have heated soil and JSC Mars-1 to 1,015˚C in order to eliminate all organic molecules, and we are currently performing DS experiments on extracts taken from these samples. Furthermore, we've developed nonlinear dielectric response techniques, which will also be tested for their ability to differentiate living from sterile material in extraterrestrial settings.