Paper ID: 86148
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22nd IAA SYMPOSIUM ON BUILDING BLOCKS FOR FUTURE SPACE EXPLORATION AND DEVELOPMENT (D3)
Systems and Infrastructures to Implement Sustainable Space Development and Settlement - Systems (2A)

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CABIN ATMOSPHERE FILTRATION USING AMBIENT AIR IONIZATION

Abstract

The mitigation of microbial life, encompassing bacteria and fungi, in the microgravity environment on the International Space Station presents heightened challenges compared to terrestrial environments. Consequently, astronauts frequently contend with prevalent bacterial and fungal infections due to constant exposure in confined spaces. Addressing this issue necessitates the development of a cost-effective and low-waste mechanism for the continuous neutralization of bacteria and fungi. One promising solution is ambient air ionization. Cabin Atmosphere Filtration using Ambient Air Ionization (CAFAAI) is a specialized ambient air ion thruster, created to neutralize microbial life. It operates on a voltage amplifier circuit that converts low-voltage AC into high-voltage, low-current DC. This conversion is crucial for producing an electric field concentrated enough for effective ionization, typically around 10 kV, but with effectiveness increasing up to a certain voltage threshold. This study tests CAFAAI's effectiveness in neutralizing Auerobasidium pullulans, a fungus found on the International Space Station. Cultures of A. pullulans were nebulized and introduced into agar plates in two distinct manners: direct injection and pre-treatment through CAFAAl. The comparison of the growth of surviving spores on these plates provided valuable insights into the effectiveness of ambient air ionization for microbial neutralization in microgravity environments. Additionally, due to CAFAAI utilizing large electric fields to remove electrons from molecules, byproduct production, including ozone, was also considered. Ozone's affinity towards targeting double-bonded molecules would make it valuable for applications in space station environments, such as cleaning surfaces or treating clothing. CAFAAI could serve as a reliable source of ozone for experiments and cleaning procedures. Furthermore, the resulting ozone can be efficiently converted into a more stable molecule, oxygen, utilizing a metal oxide catalyst.