Paper ID: 103660
interactive
student

IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Late Breaking Abstracts (LBA) (LBA)

Author: Mr. HARSH VERMA
India

MICROGRAVITY-ENABLED FABRICATION OF HYBRID INTERMETALLIC COMPOSITES FOR IN-ORBIT AEROSPACE APPLICATIONS

Abstract

This study explores the microgravity-enabled fabrication of hybrid intermetallic composites joining SS321 stainless steel and AA2219 aluminum alloy using nanostructured interlayers. Microgravity conditions, simulated via parabolic flights and modeled numerically, eliminate buoyancy-driven convection, enabling uniform diffusion, refined grain structures, and minimized brittle intermetallic formation. The joints exhibited superior thermal, mechanical, and corrosion resistance—essential for aerospace use. Specimens were tested under simulated Low Earth Orbit (LEO) conditions, including thermal cycling, vacuum, atomic oxygen, and UV radiation. Results confirmed excellent stability and resistance to degradation. The absence of convective heat flow allowed in-depth study of solid-state diffusion kinetics and phase transformations under space-relevant gradients. These findings highlight the potential of microgravity to tailor dissimilar metal joints for spacecraft, satellites, and orbital infrastructure. The demonstrated feasibility of in-space fabrication supports scalable, autonomous manufacturing and in-situ resource utilization (ISRU), offering a transformative step toward sustainable long-duration missions and deep space exploration goals.