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Science and Technology for Tomorrow's Air and Space Force

Success Story

SPACE-SURVIVABLE MATERIALS GET BOOST WITH NEW POLYMERS

Hybrid inorganic and organic polymer research at the Propulsion Directorate's Edwards Research Site demonstrated the ability to prevent damage from a simulated space environment. Test samples are currently flying on the International Space Station.

Polyhedral oligomeric silsesquioxane (POSS) technology research is bridging the gap between ceramics and plastics. Directorate scientists and engineers believe that the incorporation of POSS into polymers could increase the survivability of polymeric materials in low-earth orbit (LEO) indefinitely. This would result in increased satellite lifetimes.

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Accomplishment

Directorate analysis of POSS-copolymers exposed to a simulated LEO environment revealed the formation of a protective silica layer on the surface of the polymer. This layer prevented degradation of the underlying polymer when exposed to atomic oxygen flux.

In fact, tests showed that exposure to simulated LEO conditions healed microcracks initially present in certain POSS-copolymer samples. The dispersion of POSS throughout the polymer matrix provided efficient self-healing of damaged areas. The Materials for the International Space Station Experiment is currently testing POSS materials in space, with plans to test other samples on future missions.

Background

POSS technology research at the directorate is a rapidly evolving area of dual-use technology development. The Edwards Research Site provides military and industrial users with innovative polymer materials that will double or triple satellite lifetimes.

POSS-copolymer materials' technology is a revolutionary step toward the development of space-survivable materials and will enhance the long-term deployment of space-inflatable structures, antennas, solar arrays, and solar sails. Polymeric materials offer many advantages for LEO applications including ease of processing and reduced payload-to-orbit costs from the reduction in weight.

However, polymers currently used in the construction of space vehicles undergo severe degradation, resulting in reduced spacecraft lifetimes since they must endure high fluxes of atomic oxygen, bombardment by low- and high-energy charged particles, extreme temperature changes, and solar radiation. Degradation of these materials may also be detrimental to electrical components on spacecraft.

Propulsion
Emerging Technologies

Additional information

To receive more information about this or other activities in the Air Force Research Laboratory, contact TECH CONNECT, AFRL/XPTC, (800) 203-6451 and you will be directed to the appropriate laboratory expert. (03-PR-12)