Hybrid Plastics™

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Hybrid Plastics' POSS® Nanocomposites Successfully Complete the First Half of their Mission in Space

Fountain Valley, CA: As a new space material candidate, POSS® Nanoreinforced™ polymers, have shown a dramatic improvement over existing polymer and composite technologies. Polymeric materials offer many advantages for space applications including ease of processing and reduced payload-to-orbit costs derived from a reduction in weight. However, over the last two decades it has been well established that polymers used in the construction of space vehicles and platforms undergo severe degradation resulting in reduced spacecraft lifetimes. These materials degrade because spacecraft surfaces in low Earth orbit must endure high Atomic Oxygen (AO) flux, bombardment by charged particles, and thermal cycling along the full spectrum of solar radiation.

Testing of polymers containing Nanostructured™ POSS® reveal that they are radiation insensitive and provide at least a ten (10) fold improvement in the AO erosion rate over existing materials, such as Kapton®.[1] This order of magnitude change will enable the development of a new generation of novel space survivable materials.

Hybrid Plastics™ has partnered with the Air Force in developing POSS® technology for space applications. The Air Force Research Laboratory at Edwards AFB CA, in collaboration with NASA and Boeing, secured the space flight and the space qualification for POSS®-Polymers on the International Space Station (ISS). Nine POSS®-polymer samples, including a POSS®-Kapton®, were submitted to participate in the Materials on International Space Station Experiment (MISSE). MISSE is a cooperative experiment involving Principal Investigators from Boeing Phantom Works, the Air Force Research Laboratory, and NASA's Langley Research Center and Marshall Space Flight Center and Glenn Research Center.

Astronaut installing one the Passive Experiment Containers containing POSS® Nanocomposites onto the International Space Station during STS-105.

[1] Gonzalez R.I., *Synthesis and In-Situ Atomic Oxygen Erosion Studies of Space Survivable Organic/Inorganic POSS Polymers*, PhD Dissertation, Chemical Engineering Department, University of Florida, May 2002

The MISSE was transported to the ISS and attached to the exterior of the ISS during the STS 105 mission on 10 August 2001. The MISSE will be exposed to the space environment for 14 months while on the ISS. The experiment utilizes Passive Experiment Containers (PECs) developed by Langley Research Center (LaRC) and first used for ISS Phase I Risk Mitigation Experiments on Mir. The figure shows an astronaut installing one of the PEC trays containing the POSS® samples onto the exterior of one of the airlocks on the ISS. Analysis reveals that these Nanoreinforced™ polymers rapidly form a ceramic-like passivating SiO_2 layer that prevents further degradation of the underlying virgin polymer.

POSS® is a revolutionary new Nanotechnology based on silicon-derived materials that provide nanometer-scale control to dramatically improve the thermal and mechanical properties of traditional polymers while offering easy incorporation using existing manufacturing protocols. These compounds have an average diameter of just 1.5 nanometers, or billionth of a meter. POSS® nanomaterials can be used both as direct replacements for hydrocarbon based materials or as low-density performance additives to traditional plastics. They are biocompatible, recyclable, non-flammable, and competitively priced with traditional polymer feedstocks. POSS® Nanostructured™ materials can be readily incorporated into virtually any existing polymer system through blending, grafting or copolymerization. These hybrid nanochemicals had been hailed by R&D magazine as one of the 100 most technologically significant new products for the year 2000.

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