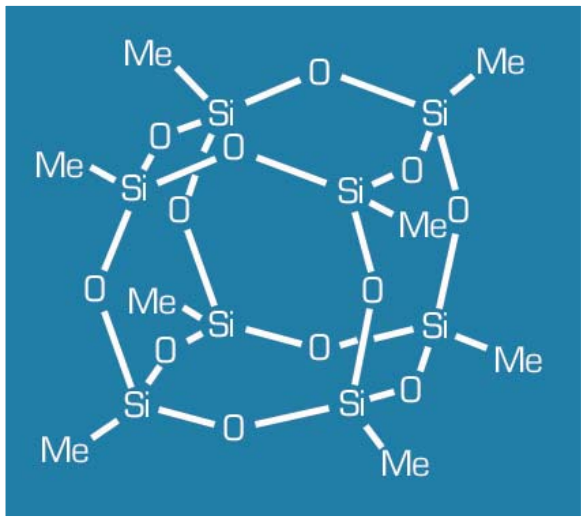
Commercialization of Nano-Composites for Space Systems Insulation

Accomplishment: Nanostructured silicate molecules, polyhedral oligomeric silsesquioxanes (POSS), were developed and commercialized. These POSS molecules have been dispersed in conventional polymers, producing nano-composite materials with improved thermal and physical properties.



Impact: POSS has been added to solid rocket motor insulation, achieving a major goal of 25% reduction in the insulation erosion rate. This results in a 22% decrease in insulation weight and a 4% increase in booster payload capabilities for launch systems such as the Atlas V solid rocket motor. POSS addition to Kapton plastic, used for thermal protection in satellites, delivers an increase in service life of five years or more. Commercialization has reduced the minimum price of POSS from $1000 to $20 per pound.

Motivation and Approach: Organic materials such as plastics and rubbers are attractive aerospace insulation materials due to their low weight, low thermal conductivity and processibility. However, they have poor resistance to aggressive space systems environments that include high temperatures and corrosive gases in launch systems and erosive atomic oxygen in the orbit of most satellites. The silicate structure of the POSS core gives good stability in aggressive environments, and the chemical groups attached to the corners of the silicate molecule core allow POSS to be easily incorporated into a wide range of organic materials. POSS was first added to organic materials at AFRL. This accomplishment has led to significant improvements in a broad range of material properties. The processability of resulting nano-composite materials is retained as a result of the nanometer-sized POSS additions, so that existing manufacturing processes can be used. Commercialization has been achieved through a Cooperative Research and Development Agreement (CRADA) and patent licensing agreements with Hybrid Plastics, Inc.

Team: This advancement was accomplished in the Propulsion Directorate by a team of 11 scientists and engineers, led by Dr. Joe Mabry. A spin-off company, Hybrid Plastics, Inc., was created in order to commercialize this new technology.