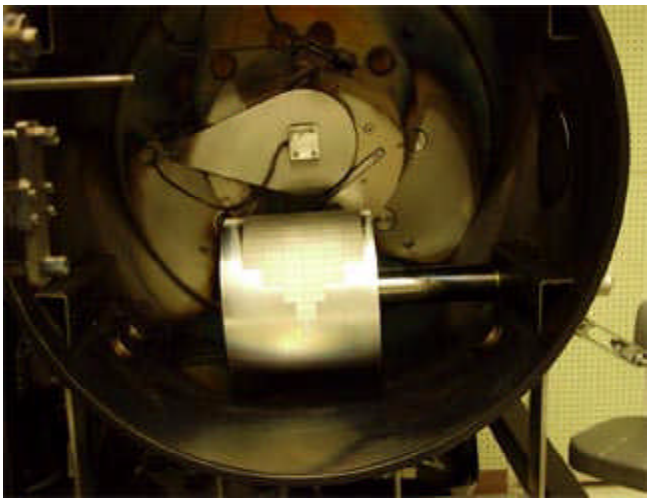
Solar Selective Coatings Developed for Space Power Applications

A solar collector having the combined properties of high solar absorptance, low infrared emittance, and high thermal conductivity is envisioned for space power applications on minisatellites. A high solar absorptance is needed to collect as much of the incident solar radiation as possible and a low infrared emittance is needed to minimize radiant energy losses. A lightweight material having a high thermal conductivity is needed to transport the absorbed energy to where it is needed. Such a solar collector may be used with a low-temperature-differential heat engine to provide electric power to the minisatellite components or as a source of thermal energy for a thermal bus that would heat remote regions of the spacecraft.

The key to such a collector is the use of cermet coatings. Cermet coatings are composed of molecular islands of metal embedded in a three-dimensional matrix of dielectric. Recent research on molecular mixtures of aluminum and aluminum oxide at the NASA Glenn Research Center has yielded cermet coatings with a solar absorptance α of 0.797 and an infrared emittance ε of 0.131, yielding an α/ε ratio of 6. Although additional work is needed to further increase the α/ε ratio, these coatings are attractive owing to their potential durability in the space environment. The aluminum oxide surface should provide substantial protection from the atomic oxygen found in low Earth orbit. To help minimize emittance, these coatings are deposited on a smooth surface. The selected surface is aluminum that has been diamond turned to a mirror finish.



Cylindrical aluminum sputter deposition target with aluminum oxide pieces installed.

Cermet coatings are manufactured by sputter deposition. To achieve the desired variable composition, Glenn's researchers implemented a novel approach using a cylindrical target composed of aluminum and aluminum oxide. Rotating the cylinder during the deposition process yields a coating of variable composition. The figure shows a photograph of the custom-made aluminum and aluminum oxide cylindrical target installed in the sputter

deposition chamber.

For more information, visit Glenn's Electro-Physics Branch online.
http://www.grc.nasa.gov/WWW/epbranch/ephome.htm

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