surface is integral with the underlying silicone and is sufficiently thin enough that the elastomers retain their flexibility and sealing properties, yet the silicone does not stick to surfaces because the surface is essentially a thin film of SiO_2 glass.

Silicone seals are mounted on the surface of electrically grounded aluminum exposure plates or suspended such that the interfacing silicone seal surfaces are exposed to a low-pressure atmospheric plasma. The seal surfaces are then exposed to atomic oxygen, until the desired reduction in seal adhesion is achieved. Polyimide Kapton H atomic oxygen fluence witness samples are also placed into the vacuum chamber during air plasma exposure to measure the Kapton effective fluence by weight loss of vacuum dehydrated Kapton H samples.

Functional operation of the seals is such that the atomic oxygen treated surface will then interface during docking with another atomic oxygen treated surface or a metal surface. Thus, the mating is between two opposing silica surfaces on silicone or silica surfaces on smooth metal surfaces.

The atomic oxygen treated silicone seal geometry can be varied as well as the composition of the silicone. Parts of the seal can be treated rather than all of the seal if it is desirable to have adhesion in a specific direction or at a specific interface.

This work was done by Bruce A. Banks and Sharon K. Miller of Glenn Research Center. Further information is contained in a TSP (see page 1).

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steven Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-18572-1.

Optimal Flow Control Design

This design results in a quieter and more environmentally friendly transport aircraft.

Langley Research Center, Hampton, Virginia

In support of the Blended-Wing-Body aircraft concept, a new flow control hybrid vane/jet design has been developed for use in a boundary-layer-ingesting (BLI) offset inlet in transonic flows. This inlet flow control is designed to minimize the engine fan-face distortion levels and the first five Fourier harmonic half amplitudes while maximizing the inlet pressure recovery. This concept represents a potentially enabling technology for quieter and more environmentally friendly transport aircraft.

An optimum vane design was found by minimizing the engine fan-face distortion, DC60, and the first five Fourier harmonic half amplitudes, while maximizing the total pressure recovery. The optimal vane design was then used in a BLI inlet wind tunnel experiment at NASA Langley's 0.3-meter transonic cryogenic tunnel. The experimental results demonstrated an 80-percent decrease in DPCPavg, the reduction in the circumferential distortion levels, at an inlet mass flow rate corresponding to the middle of the operational range at the cruise condition.

Even though the vanes were designed at a single inlet mass flow rate, they performed very well over the entire inlet mass flow range tested in the wind tunnel experiment with the addition of a small amount of jet flow control. While the circumferential distortion was decreased, the radial distortion on the outer rings at the aerodynamic interface plane (AIP) increased. This was a result of the large boundary layer being distributed from the bottom of the AIP in the baseline case to the outer edges of the AIP when using the vortex generator (VG) vane flow control.

Experimental results, as already mentioned, showed an 80-percent reduction of DPCPavg, the circumferential distortion level at the engine fan-face. The hybrid approach leverages strengths of vane and jet flow control devices, increasing inlet performance over a broader operational range with significant reduction in mass flow requirements. Minimal distortion level requirements are met using vanes alone, avoiding engine stall and increasing robustness of this hybrid inlet flow control approach. This design applies to aerospace applications needing flush-mounted boundary-layer-ingesting inlets.

This work was done by Brian Allan and Lewis Owens of Langley Research Center. For further information, contact the Langley Innovative Partnerships Office at (757) 864-8881. LAR-17365-1

Corrosion-Resistant Container for Molten-Material Processing

A combination of materials functions and survives in hot, corrosive environments.

John H. Glenn Research Center, Cleveland, Ohio

In a carbothermal process, gaseous methane is passed over molten regolith, which is heated past its melting point to a temperature in excess of 1,625 °C. At this temperature, materials in contact with the molten regolith (or regolith simulant) corrode and lose their structural properties. As a result, fabricating a crucible to hold the molten material and providing a method of contact heating have been problematic.

Alternative containment approaches use a large crucible and limit the heat zone of the material being processed, which is inefficient because of volume and mass constraints. Alternative heating approaches use non-contact heating, such as by laser or concentrated solar energy, which can be inefficient in transferring heat and thus require higher power heat sources to accomplish processing.

The innovation is a combination of materials, with a substrate material having high structural strength and stiffness and high-temperature capability, and a coating material with a high corrosion resistance and high-temperature capability. The material developed is a molybdenum substrate with an iridium coating. Creating the containment crucible or heater jacket using this material combination requires only that the molybdenum, which is easily processed by conventional methods such as milling, electric discharge machining, or forming and brazing, be fabricated into an appropriate shape, and that the iridium coating be applied to any surfaces that may come in contact with the corrosive molten material.

In one engineering application, the molybdenum was fashioned into a container for a heat pipe. Since only the end of the heat pipe is used to heat the regolith, the container has a narrowing end with a nipple in which the heat pipe is snugly fit, and the external area of this nipple, which contacts the regolith to transfer heat into it, is coated with iridium.

At the time of this reporting, no single material has been found that can perform the functions of this combination of materials, and other combinations of materials have not proven to be survivable to the corrosiveness of this environment.

High-temperature processing of materials with similar constituencies as lunar regolith is fairly common. The carbothermal process is commonly used to make metallurgical-grade silicon for the semiconductor and solar-cell industries.

This work was done by Theodore G. Stern and Eric McNaul of DR Technologies for Glenn Research Center.

Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steve Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-18459-1.