



## Books & Reports

### Airborne Hyperspectral Imaging System

A document discusses a hyperspectral imaging instrument package designed to be carried aboard a helicopter. It was developed to map the depths of Greenland's supraglacial lakes. The instrument is capable of telescoping to twice its original length, allowing it to be retracted with the door closed during take-off and landing, and manually extended in mid-flight. While extended, the instrument platform provides the attached hyperspectral imager a nadir-centered and unobstructed view of the ground.

Before flight, the instrument mount is retracted and securely strapped down to existing anchor points on the floor of the helicopter. When the helicopter reaches the destination lake, the door is opened and the instrument mount is manually extended. Power to the instrument package is turned on, and the data acquisition computer is commanded via a serial cable from an on-board user-operated laptop to begin data collection. After data collection is complete, the instrument package is powered down and the mount retracted, allowing the door to be closed in preparation for landing.

The present design for the instrument mount consists of a three-segment telescoping cantilever to allow for a sufficient extended length to see around the landing struts and provide a nadir-centered and unobstructed field of view for the hyperspectral imager. This instrument works on the premise that water preferentially absorbs light with longer wavelengths on the red side of the visible spectrum. This property can be exploited in order to remotely determine the depths of bodies of pure freshwater. An imager flying over such a lake receives light scattered from the surface, the bulk of the water column, and from the lake bottom. The strength of absorption of longer-wavelength light depends on the depth of the water column. Through calibration with *in situ* measurements of the water depths, a depth-determining algorithm may be

developed to determine lake depth from these spectral properties of the reflected sunlight.

*This work was done by Alberto E. Behar and Moogega Cooper of Caltech; John Adler of NOAA; and Tobias Jacobson of the University of Southern California for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-48141*

### Heat Shield Employing Cured Thermal Protection Material Blocks Bonded in a Large-Cell Honeycomb Matrix

A document describes a new way to integrate thermal protection materials on external surfaces of vehicles that experience the severe heating environments of atmospheric entry from space. Cured blocks of thermal protection materials are bonded into a compatible, large-cell honeycomb matrix that can be applied on the external surfaces of the vehicles. The honeycomb matrix cell size, and corresponding thermal protection material block size, is envisioned to be between 1 and 4 in. ( $\approx 2.5$  and 10 cm) on a side, with a depth required to protect the vehicle. The cell wall thickness is thin, between 0.01 and 0.10 in. ( $\approx 0.025$  and 0.25 cm).

A key feature is that the honeycomb matrix is attached to the vehicle's unprotected external surface prior to insertion of the thermal protection material blocks. The attachment integrity of the honeycomb can then be confirmed over the full range of temperature and loads that the vehicle will experience.

Another key feature of the innovation is the use of uniform-sized thermal protection material blocks. This feature allows for the mass production of these blocks at a size that is convenient for quality control inspection. The honeycomb that receives the blocks must have cells with a compatible set of internal dimensions. The innovation involves the use of a faceted subsurface under the honeycomb. This provides a predictable surface with perpendicular cell walls for the majority of the blocks. Some cells

will have positive tapers to accommodate mitered joints between honeycomb panels on each facet of the subsurface. These tapered cells have dimensions that may fall within the boundaries of the uniform-sized blocks.

*This work was done by Peter Zell of Ames Research Center. Further information is contained in a TSP (see page 1). ARC-16018-1*

### Asymmetric Supercapacitor for Long-Duration Power Storage

A document discusses a project in which a series of novel hybrid positive electrode materials was developed and tested in asymmetric capacitors with carbon negative electrodes. The electrochemical performance of the hybrid capacitors was characterized by cyclic voltammetry and a DC charge/discharge test. The hybrid capacitor exhibited ideal capacitor behavior with an extended operating voltage of 1.6 V in aqueous electrolyte, and energy density higher than activated carbon-based supercapacitors.

Nanostructured  $\text{MnO}_2$  is a promising material for electrochemical capacitors (ECS) because of its low cost, environmentally friendly nature, and reasonably high specific capacitance. The charge capacity of the capacitors can be further improved by increasing the specific surface area of the  $\text{MnO}_2$  electrode material. The power density and space radiation stability of the capacitors can be enhanced by coating the  $\text{MnO}_2$  nanoparticles with conducting polymers. The conducting polymer coating also helps in radiation-hardening the ECS.

*This work was done by Krishnaswamy K. Rangan and Tirumalai S. Sudarshan of Materials Modification, Inc. for 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-18751-1.*