an insulating material or else covered with another insulating material wrapped in S-glass prior to the winding process. A ceramic binding agent is applied as a slurry during the winding process to provide further insulating capability. The turns are pre-bent during winding to prevent damage to the insulation. The coil is then heated to convert the binder into ceramic. The instant report mostly reiterates the prior information and presents some additional information on the application of the ceramic binding agent and the incorporation of high-temperature wire into the windings.

This work was done by Albert F. Kascak and Gerald T. Montague of **Glenn Research Center** *and Alan Palazzolo, Jason Preuss, Bart Carter, Randall Tucker, and Andrew Hunt of Texas A&M University. 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, Commercial Technology Office, Attn: Steve Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-17467-1.

SMART Solar Sail

A report summarizes the design concept of a super miniaturized autonomous reconfigurable technology (SMART) solar sail — a proposed deployable, fully autonomous solar sail for use in very fine station keeping of a spacecraft. The SMART solar sail would include a reflective film stretched among nodes of a SMART space frame made partly of nanotubule struts. A microelectromechanical system (MEMS) at each vertex of the frame would spool and unspool nanotubule struts between itself and neighboring nodes to vary the shape of the frame. The MEMSs would be linked, either wirelessly or by thin wires within the struts, to an evolvable neural software system (ENSS) that would control the MEMSs to reconfigure the sail as needed. The solar sail would be highly deformable from an initially highly compressed configuration, yet also capable of enabling very fine maneuvering of the spacecraft by means of small sail-surface deformations. The SMART Solar Sail would be connected to the main body of the spacecraft by a SMART multi-tether structure, which would include MEMS actuators like those of the frame plus tethers in the form of longer versions of the struts in the frame.

This work was done by Steven A. Curtis of **Goddard Space Flight Center**. *Further information is contained in a TSP (see page 1).*
GSC-14762-1

Further Developments in Microwave Ablation of Prostate Cells

A report presents additional information about the subject matter of "Microwave Treatment of Prostate Cancer and Hyperplasia" (MSC-23049), *NASA Tech Briefs*, Vol. 29, No. 6 (June 2005), page 62. To recapitulate: the basic idea is to use microwaves to heat and thereby kill small volumes of unhealthy prostate tissue. The prostate is irradiated with microwaves from one or more antennas positioned near the prostate by means of catheters inserted in the urethra and/or colon. The microwave frequency, power, and exposure time, phasing, positions, and orientations of the antennas may be chosen to obtain the desired temperature rise in the heated region and to ensure that the location and extent of the heated region coincides with the region to be treated to within a few millimeters. Going beyond the description in the cited previous article, the report includes a diagram that illustrates typical placement of urethra and colon antenna catheters and presents results of computationally simulated prostate-heating profiles for several different combinations of antenna arrangements, frequencies, and delivered-energy levels as well as experimental results within phantom materials. The advantage of the two-antenna technology is that the heat generated at each antenna is significantly reduced from that associated with only one antenna. The microwave energy radiated from each antenna is focused at the tumor center by adjusting the phasing of the irradiated microwave signal from the antennas.

This work was done by G. Dickey Arndt and Phong Ngo of **Johnson Space Center** *and Jim R. Carl and George W. Raffoul, independent consultants.*

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be addressed to the Patent Counsel, Johnson Space Center, (281) 483-0837. Refer to MSC-23427.

Imaging Dot Patterns for Measuring Gossamer Space Structures

A paper describes a photogrammetric method for measuring the changing shape of a gossamer (membrane) structure deployed in outer space. Such a structure is typified by a solar sail comprising a transparent polymeric membrane aluminized on its Sun-facing side and coated black on the opposite side. Unlike some prior photogrammetric methods, this method does not require an artificial light source or the attachment of retroreflectors to the gossamer structure. In a basic version of the method, the membrane contains a fluorescent dye, and the front and back coats are removed in matching patterns of dots. The dye in the dots absorbs some sunlight and fluoresces at a longer wavelength in all directions, thereby enabling acquisition of high-contrast images from almost any viewing angle. The fluorescent dots are observed by one or more electronic camera(s) on the Sun side, the shade side, or both sides. Filters that pass the fluorescent light and suppress most of the solar spectrum are placed in front of the camera(s) to increase the contrast of the dots against the background. The dot image(s) in the camera(s) are digitized, then processed by use of commercially available photogrammetric software.

This work was done by A. A. Dorrington, P. M. Danehy, T. W. Jones, R. S. Pappa, and J. W. Connell of **Langley Research Center**. *Further information is contained in a TSP (see page 1).*
LAR-16596-1

Development of Flexible Multilayer Circuits and Cables

A continuing program addresses the development of flexible multilayer electronic circuits and associated flexible cables. This development is undertaken to help satisfy aerospace-system-engineering requirements for efficient, lightweight electrical and electronic subsystems that can fit within confined spaces, adhere to complexly shaped surfaces, and can be embedded within composite materials. Heretofore, substrate layers for commercial flexible circuitry have been made from sheets of Kapton (or equivalent) polyimide and have been bonded to copper conductors and to other substrate layers by means of adhesives. The substrates for the present developmental flexible circuitry are made from thin films of a polyimide known as LaRC™-SI. This polyimide is thermoplastic and, therefore, offers the potential to eliminate delamination and the need for adhesives. The development work undertaken thus far includes experiments in the use of several techniques of design and fabrication (including computer-aided design and fabrication) of representative flexible circuits. Anticipated fu-