

ditions (typically between 1 and 3 V), ions of a metal (silver) are formed at an anode made of that metal and migrate into the solid electrolyte while electrons (typically at a current of the order of microamperes to milliamperes) are injected from an electrochemically inert (nickel) cathode into the solid electrolyte. The injected electrons reduce the metal anions in the solid electrolyte, thereby causing the growth of metal nanowires through the electrolyte from the cathode to the corresponding anode.

Once a nanowire has grown sufficiently to form an electrically conductive path between the electrodes, there is no need to continue to apply electric power to maintain the connection. The process of making the connection can be easily reversed by applying a reverse bias to re-

oxidize the metal atoms in the solid electrolyte to recreate the insulating amorphous layer. Thus, a nanoionics-based switch is a reversible electrochemical switch that can have geometric features as small as nanometers. The process time for making or breaking the connection is about a nanosecond.

Experimental nanoionics based-switches having several different configurations have been built and tested in a continuing effort to gain understanding of the underlying chemical and physical principles and optimize designs. Fabrication of each experimental switch began with deposition of a binary chalcogenide glass on a high-resistivity silicon wafer. Next, a layer of silver was deposited on the glass and exposed to ultraviolet light to induce a photodissolution process in which silver ions mi-

grated into the glass matrix. Then an electrode of silver and an electrode of nickel were deposited on the chalcogenide layer.

The figure shows plots of data from a test of one of the experimental switches. Over the frequency range from 1 to 6 GHz, the insertion loss of the switch in the "on" state was less than 0.5 dB, while the isolation in the "off" state exceeded 30 dB.

This work was done by James Nessel and Richard Lee 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: Steve Fedor, Mail Stop 4-8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-18313-1.

Lunar Dust-Tolerant Electrical Connector

John H. Glenn Research Center, Cleveland, Ohio

An electrical connector was developed that is tolerant of the presence of lunar dust. Novel features of the connector include the use of a permeable membrane to act both as a dust barrier and as a wiper to limit the amount of dust that makes its way into the internal chamber of the connector. The development focused on the Constellation lunar extravehicular activity (EVA) spacesuit's portable life support system (PLSS) battery recharge connector; however, continued research is applying this technology to other lunar surface systems such as lunar rover subsystems and cryogenic fluid transfer connections for *in-situ* resource utilization (ISRU) applications.

Lunar dust has been identified as a significant and present challenge in fu-

ture exploration missions. In addition to posing contamination and health risks for human explorers, the interlocking, angular nature of lunar dust and its broad grain size distribution make it particularly harmful to mechanisms with which it may come into contact. All Apollo lunar missions experienced some degree of equipment failure because of dust, and it appears that dust accumulation on exposed material is unavoidable and difficult to reverse. Both human EVA and ISRU activities are on the mission horizon and are paramount to the establishment of a permanent human base on the Moon. Reusable and dust-tolerant connection mechanisms are a critical component for mission success.

The need for dust-tolerant solutions is also seen in utility work and repair, mass transit applications, construction, mining, arctic and marine environments, diving (search and rescue), and various operations in deserts, where dust or sand clogging and coating different mechanisms and connections may render them difficult to operate or entirely inoperable.

This work was done by Jason Herman, Shazad Sadick, and Dustyn Roberts of Honeybee Robotics Spacecraft Mechanisms Corporation 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-18400-1.

Compact, Reliable EEPROM Controller

This controller prevents inadvertent writes in an EEPROM.

Goddard Space Flight Center, Greenbelt, Maryland

A compact, reliable controller for an electrically erasable, programmable read-only memory (EEPROM) has been developed specifically for a space-flight application. The design may be adaptable to other applications in which there are requirements for reliability in general and, in particular, for preven-

tion of inadvertent writing of data in EEPROM cells.

Inadvertent writes pose risks of loss of reliability in the original space-flight application and could pose such risks in other applications. Prior EEPROM controllers are large and complex and do not provide all reasonable protec-

tions (in many cases, few or no protections) against inadvertent writes. In contrast, the present controller provides several layers of protection against inadvertent writes. The controller also incorporates a write-time monitor, enabling determination of trends in the performance of an EEPROM.