Books & Reports

In Situ Potassium-Argon Geochronology Using Fluxed Fusion and a Double Spike

A document highlights an Li-based fluxing agent that enables sample fusion and quantitative Ar-release at relatively low temperatures (900–1,000 °C), readily achievable with current flight resistance furnace designs. A solid, double spike containing known quantities of ^{39}Ar and ^{41}K was developed that, when added in known amounts to a sample, enables the extraction of a $^{40}Ar/^{40}K$ ratio for age estimation without a sample mass measurement.

The use of a combination of a flux and a double spike as a means of solving the mechanical hurdles to an *in situ* K-Ar geochronology measurement has never been proposed before. This methodology and instrument design would provide a capability for assessing the ages of rocks and minerals on the surfaces of planets and other rocky terrestrial bodies in the solar system.

This work was done by Joel A. Hurowitz, Michael H. Hecht, Wayne F. Zimmerman, Evan L. Neidholdt, Mahadeva P. Sinha, Wolfgang Sturhahn, Max Coleman, Daniel J. McCleese, Kenneth A. Farley, John M. Eiler, and George R. Rossman of Caltech, and Kathryn Waltenberg of the University of Queensland, Australia, for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-48099

Fiber-Optic Micrometeoroid/Orbital Debris Impact Detector System

A document describes a reliable, lightweight micrometeoroid/orbital debris (MMOD) detection system that can be located at strategic positions of "high consequence" to provide real-time warning of a penetration, its location, and the extent of the damage to a spacecraft.

The concept is to employ fiber-optic sensors to detect impact damage and penetration of spacecraft structures. The fibers are non-electrical, employ light waves, and are immune to electromagnetic interference.

The fiber-optic sensor array can be made as a standalone product, being bonded to a flexible membrane material or a structure that is employed as a MMOD shield material. The optical sensors can also be woven into hybrid MMOD shielding fabrics. The glass fibers of the fiber-optic sensor provide a dual purpose in contributing to the breakup of MMOD projectiles. The grid arrays can be made in a modular configuration to provide coverage over any area desired. Each module can be connected to a central scanner instrument and be interrogated in a continuous or periodic mode.

This work was done by Eric L. Christiansen of Johnson Space Center and R.C. Tennyson and W.D. Morison of Fiber Optic Systems Technology Inc. (FOX-TEK). Further information is contained in a TSP (see page 1).

In accordance with Public Law 96-517, the contractor has elected to retain title to this invention. Inquiries concerning rights for its commercial use should be addressed to:

Fiber Optic Systems Technology Inc.
4580 Dufferin St. Suite 402
Toronto, Ontario, Canada M3H 5Y2

Refer to MSC-23934-1, volume and number of this NASA Tech Briefs *issue, and the page number.*

Nanostructure Secondary-Mirror Apodizing Mask for Transmitter Signal Suppression in a Duplex Telescope

A document discusses a nanostructure apodizing mask, made of multi-walled carbon nanotubes, that is applied to the centers (or in and around the holes) of the secondary mirrors of telescopes that are used to interferometrically measure the strain of space-time in response to gravitational waves. The shape of this ultra-black mask can be adjusted to provide a smooth transition to the clear aperture of the secondary mirror to minimize diffracted light.

Carbon nanotubes grown on silicon are a viable telescope mirror substrate, and can absorb significantly more light than other black treatments. The hemispherical reflectance of multi-walled carbon nanotubes grown at GSFC is approximately 3 to 10 times better than a standard aerospace paint used for stray light control. At the LISA (Laser Interferometer Space Antenna) wavelength of 1 micron, the advantage over paint is a factor of 10.

Primarily, in the center of the secondary mirror (in the region of central obscuration, where no received light is lost) a black mask is applied to absorb transmitted light that could be reflected back into the receiver. In the LISA telescope, this is in the center couple of millimeters. The shape of this absorber is critical to suppress diffraction at the edge. By using the correct shape, the stray light can be reduced by approximately 10 to the 9 orders of magnitude versus no center mask. The effect of the nanotubes has been simulated in a stray-light model. The effect of the apodizing mask has been simulated in a near-field diffraction model. Specifications are geometry-dependent, but the baseline design for the LISA telescope has been modeled as well. The coatings are somewhat fragile, but work is continuing to enhance adhesion.

This work was done by John Hagopian, Jeffrey Livas, Shahram Shiri, Stephanie Getty, June Tveekrem, and James Butler of Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-16029-1

Advanced Fire Detector for Space Applications

A document discusses an optical carbon monoxide sensor for early fire detection. During the sensor development, a concept was implemented to allow reliable carbon monoxide detection in the presence of interfering absorption signals.

Methane interference is present in the operating wavelength range of the developed prototype sensor for carbon monoxide detection. The operating parameters of the prototype sensor have been optimized so that interference with methane is minimized. In addition, simultaneous measurement of methane is implemented, and the instrument automatically corrects the carbon monoxide signal at high methane concentrations. This is possible because VCSELs (vertical cavity surface emitting lasers) with extended current tuning capabilities are implemented in the optical device. The tuning capabilities of these new laser sources are sufficient to cover the wavelength range of several absorption lines. The delivered carbon monoxide sensor (COMA 1) reliably measures low carbon monoxide levels even in the presence of high methane signals. The signal bleed-over is determined during system calibration and is then accounted for in the system parameters.