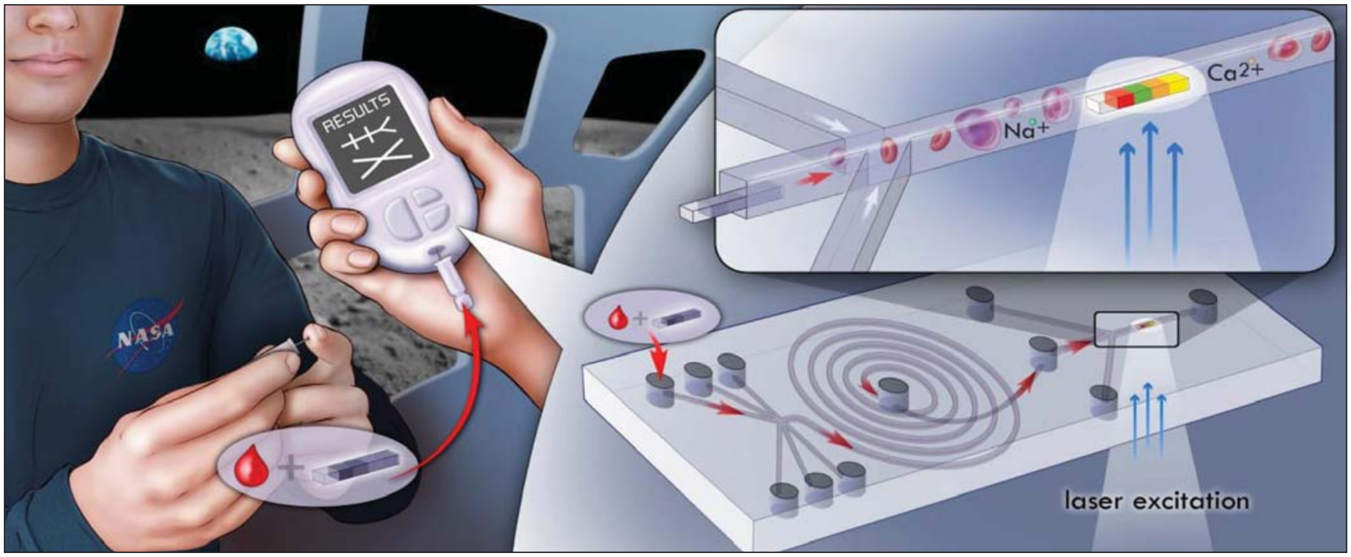


rHEALTH Universal Blood Sensor is designed to perform a breadth of analyses on blood or bodily fluids.

lowing high-sensitivity fluorescence analysis. Traditional flow cytometric profiles are obtained using this device. These include intensity versus intensity scatterplots and cell histograms. Flow-based, laser-induced fluorescence is thus a powerful technique that allows the user to have a universal detection platform for all of the assays, whether they be antibody, nanostrip, hematology, or biomarker assays. The microfluidic system allows a wide range of reagents, including antibodies, fluorescent dyes, and proprietary nanoscale test strips to be mixed with the blood sample. Typical existing commercial sensors can only perform one test at a time.

The rHEALTH device employs sophisticated flow-based detection technologies that allow a wide range of samples to be counted, analyzed, and measured with a high degree of multiplexing. The sensor is able to perform a range of analyses for cells, electrolytes, biomarkers, nucleic acids, and small molecules on a blood sample smaller than 10 µL.

This work was done by Eugene Chan of DNA Medicine Institute, 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-18727-1.

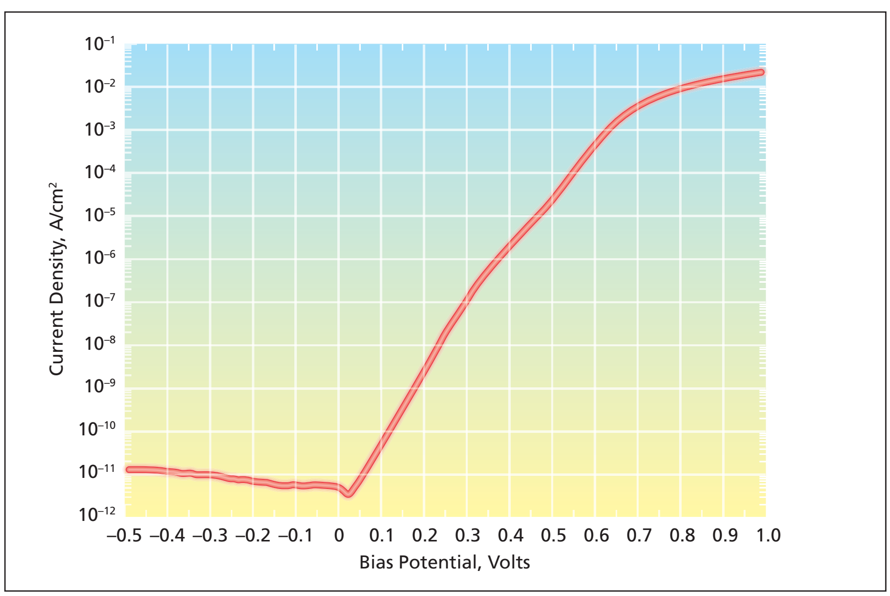
Large-Area Vacuum Ultraviolet Sensors

These devices exhibit very low dark currents.

Goddard Space Flight Center, Greenbelt, Maryland

Pt/(n-doped GaN) Schottky-barrier diodes having active areas as large as 1 cm square have been designed and fabricated as prototypes of photodetectors for the vacuum ultraviolet portion (wavelengths ≈200 nm) of the solar spectrum. In addition to having adequate sensitivity to photons in this wavelength range, these photodetectors are required to be insensitive to visible and infrared components of sunlight and to have relatively low levels of dark current.

In preparation for fabricating a batch of assorted prototype detectors, a c-plane (0001-plane) sapphire wafer was subjected to a rigorous cleaning by use of an acid and an organic solvent. Fabrication began with low-pressure metalorganic vapor-phase epitaxy of four GaN layers on the sapphire wafer: The first was a 25-nm-thick GaN nucleation layer. The second was a thicker GaN buffer



Current Density vs. Voltage was determined from measurements on device of the type described in the text.

layer to serve as a template for epitaxial growth. The third was a 3-μm-thick GaN epilayer containing electron-donor (n) doping at a density of 4.8×10^{18} cm^{-3}. The fourth was a 0.75-μm-thick GaN epilayer n-doped at a density of $\approx 10^{16}$ cm^{-3}.

Four masks were used to define features of devices having Schottky contact areas ranging up to the aforementioned maximum of 1 cm square. Mesas (one for each device) were first defined by use of conventional photolithography and chlorine-bromine reactive-ion etching for complete removal of the n epilayer. Metal patterns, each consisting of a 10-nm-thick layer of Ti followed by a 10-nm-thick layer of Ni followed by a 150-nm-thick layer of Al, were defined at the bottoms of the mesas by means of a lift-off procedure and electron-beam evaporation. These metal patterns were annealed at a temperature of 500 °C for 10 minutes in flowing nitrogen to form ohmic contacts.

Next, semitransparent Pt Schottky contacts having a thickness of 10 nm were defined on the tops of the mesas by means of a lift-off procedure. Contact rings, each consisting of a 30-nm-thick layer of Pt followed by a 150-nm-thick layer of Au, were formed on the peripheries of the semitransparent Pt Schottky areas by electron-beam evaporation and lift-off.

In preliminary tests of the electrical characteristics of these devices, forward and reverse current-vs.-voltage characteristics were measured in a dark enclosure. The measurements confirmed that as desired, these devices are characterized by low levels of dark current at low reverse bias voltage: For example, one device having an active area of 0.25 cm^2 exhibited a leakage current density of only 14 pA/cm^2 at a reverse bias of 0.5 V (see figure).

This work was done by Shahid Aslam and David Franz of Raytheon Co. for Goddard Space Flight Center. Further information is contained in a TSP (see page 1). GSC-14777-1

Fiber Bragg Grating Sensor System for Monitoring Smart Composite Aerospace Structures

Dryden Flight Research Center, Edwards, California

Lightweight, electromagnetic interference (EMI) immune, fiber-optic, sensor-based structural health monitoring (SHM) will play an increasing role in aerospace structures ranging from aircraft wings to jet engine vanes. Fiber Bragg Grating (FBG) sensors for SHM include advanced signal processing, system and damage identification, and location and quantification algorithms. Potentially, the solution could be developed into an autonomous onboard system to inspect and perform non-destructive evaluation and SHM.

A novel method has been developed to massively multiplex FBG sensors, supported by a parallel processing interrogator, which enables high sampling rates combined with highly distributed sensing (up to 96 sensors per system). The interrogation system comprises several subsystems. A broadband optical source subsystem (BOSS) and routing and interface module (RIM) send light from the interrogation system to a composite embedded FBG sensor matrix, which returns measurand-dependent wavelengths back to the interrogation system for measurement with subpicometer resolution. In particular, the returned wavelengths are channeled by the RIM to a photonic signal processing subsystem based on powerful optical chips, then passed through an optoelectronic interface to an analog post-detection electronics subsystem, digital post-detection electronics subsystem, and finally via a data interface to a computer.

A range of composite structures has been fabricated with FBGs embedded. Stress tensile, bending, and dynamic strain tests were performed. The experimental work proved that the FBG sensors have a good level of accuracy in measuring the static response of the tested composite coupons (down to submicrostrain levels), the capability to detect and monitor dynamic loads, and the ability to detect defects in composites by a variety of methods including monitoring the decay time under different dynamic loading conditions.

In addition to quasi-static and dynamic load monitoring, the system can capture acoustic emission events that can be a prelude to structural failure, as well as piezoactuator-induced ultrasonic Lamb-waves-based techniques as a basis for damage detection.

This work was done by Behzad Moslehi and Richard J. Black of Intelligent Fiber Optic Systems Corp. and Yasser Gowayed of Auburn University for Dryden Flight Research Center. Further information is contained in a TSP (see page 1). DRC-011-004

Health-Enabled Smart Sensor Fusion Technology

Stennis Space Center, Mississippi

A process was designed to fuse data from multiple sensors in order to make a more accurate estimation of the environment and overall health in an intelligent rocket test facility (IRTF), to provide reliable, high-confidence measurements for a variety of propulsion test articles.

The object of the technology is to provide sensor fusion based on a distributed architecture. Specifically, the fusion technology is intended to succeed in providing health condition monitoring capability at the intelligent transceiver, such as RF signal strength, battery reading, computing resource monitoring, and sensor data reading. The technology also provides analytic and diagnostic intelligence at the intelligent transceiver, enhancing the IEEE 1451.x-based standard for sensor data management and distributions, as well as providing appropriate communications protocols to enable complex interactions to support timely and high-quality flow of information among the system elements.

Troubleshooting is simplified through sensor fusion that allows users to inter-