alarms can be significantly decreased while still detecting fires as reliably as older smoke-detector systems do.

The present development includes fabrication of sensors that have, variously, micrometer- or nanometer-sized features so that such multiple sensors can be integrated into arrays that have sizes, weights, and power demands smaller than those of older macroscopic sensors. The sensors include resistors, electrochemical cells, and Schottky diodes that exhibit different sensitivities to the various airborne chemicals of interest. In a system of this type, the sensor readings are digitized and processed by advanced signal-processing hardware and software to extract such chemical indications of fires as abnormally high concentrations of CO and CO_2, possibly in combination with H_2 and/or hydrocarbons. The system also includes a microelectromechanical systems (MEMS)-based particle detector and classifier device to increase the reliability of measurements of chemical species and particulates.

In parallel research, software for modeling the evolution of a fire within an aircraft cargo bay has been developed. The model implemented in the software can describe the concentrations of chemical species and of particulate matter as functions of time.

A system of the present developmental type and a conventional fire detector were tested under both fire and false-alarm conditions in a Federal Aviation Administration cargo-compartment-testing facility. Both systems consistently detected fires. However, the conventional fire detector consistently generated false alarms, whereas the developmental system did not generate any false alarms.

This work was done by Gary W. Hunter, Paul Greensburg, Robert McKnight, and Jennifer C. Xu of Glenn Research Center; C. C. Liu of Case Western Reserve University; Prabir Dutta of Ohio State University; Darby Makel of Makel Engineering, Inc.; D. Blake of the Federal Aviation Administration; and Jill Sue-Antillio of Sandia National Laboratories. Further information is contained in a TSP (see page 1).

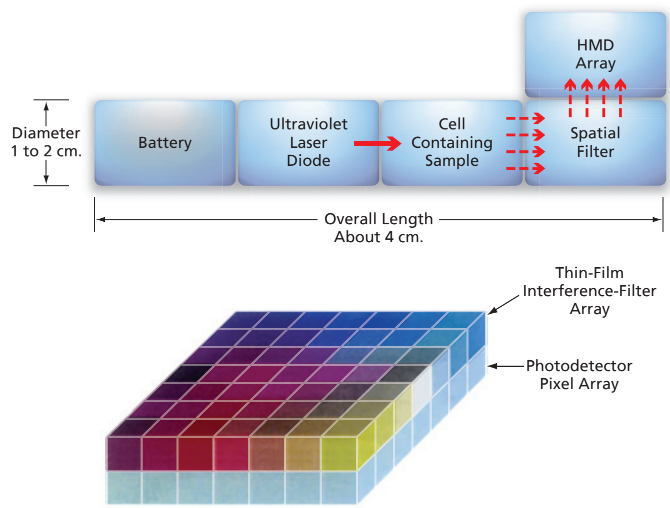
Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steve Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-18067-1.

Mosaic-Detector-Based Fluorescence Spectral Imager

This portable instrument would perform comparably to larger laboratory instruments.

NASA's Jet Propulsion Laboratory, Pasadena, California

A battery-powered, pen-sized, portable instrument for measuring molecular fluorescence spectra of chemical and biological samples in the field has been proposed. Molecular fluorescence spectroscopy is among the techniques used most frequently in laboratories to analyze compositions of chemical and biological samples. Heretofore, it has been possible to measure fluorescence spectra of molecular species at relative concentrations as low as parts per billion (ppb), with a few nm spectral resolution. The proposed instrument would include a planar array (mosaic) of detectors, onto which a fluorescence spectrum would be spatially mapped. Unlike in the larger laboratory-type molecular fluorescence spectrometers, mapping of wavelengths to spatial positions would be accomplished without use of relatively bulky optical parts. The proposed instrument is expected to be sensitive enough to enable measurement of spectra of chemical species at relative concentrations <1 ppb, with spectral resolution that could be tailored by design to be comparable to a laboratory molecular fluorescence spectrometer.



This **Pen-Sized Instrument** would measure the fluorescence spectrum of a sample with high resolution and sensitivity.

The proposed instrument (see figure) would include a button-cell battery and a laser diode, which would generate the monochromatic ultraviolet light needed to excite fluorescence in a sample. The sample would be held in a cell bounded by far-ultraviolet-transparent quartz or optical glass.

The detector array would be, more specifically, a complementary metal oxide/ semiconductor or charge-coupled-device imaging photodetector array, the photodetectors of which would be tailored to respond to light in the wavelength range of the fluorescence spectrum to be measured. The light-input face of the photodetector array would be covered with a matching checkerboard array of multilayer thin-film interference filters, such that each pixel in the array would be sensitive only to light in a spectral band narrow enough so as not to overlap significantly with the band of an adjacent pixel. The wavelength interval between adjacent pixels (and, thus, the spectral resolution) would typically be chosen by design to be approximately equal to the width of the total fluorescence wavelength range of interest divided by the number of pixels. The unitary structure comprising the photodetector array overlaid with the matching filter array would be denoted a hyperspectral mosaic detector (HMD) array.

To maximize the spatial resolution achievable by use of interference filters, it is necessary to ensure perpendicular incidence of light on the filters. In the proposed instrument, perpendicular incidence would be ensured by incorporation of a spatial filter between the sample cell and the HMD array. To minimize potential contributions of scattering of laser light, the HMD array would be oriented at a right angle to the ultraviolet laser beam.

To enable identification and characterization of molecules by use of the proposed instrument, it would be necessary to create a data library representing the HMD image outputs corresponding to fluorescence spectra of molecular species. A fully developed version of the instrument would include, as integral parts, an electronic memory containing the library and a processor for analyzing measurement data with reference to the data in the library.

This work was done by Kyung-Ah Son and Jeong Moon of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1).

Innovative Technology Assets Management
JPL
Mail Stop 202-233
4800 Oak Grove Drive
Pasadena, CA 91109-8099
(818) 354-2240
E-mail: iaoffice@jpl.nasa.gov

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