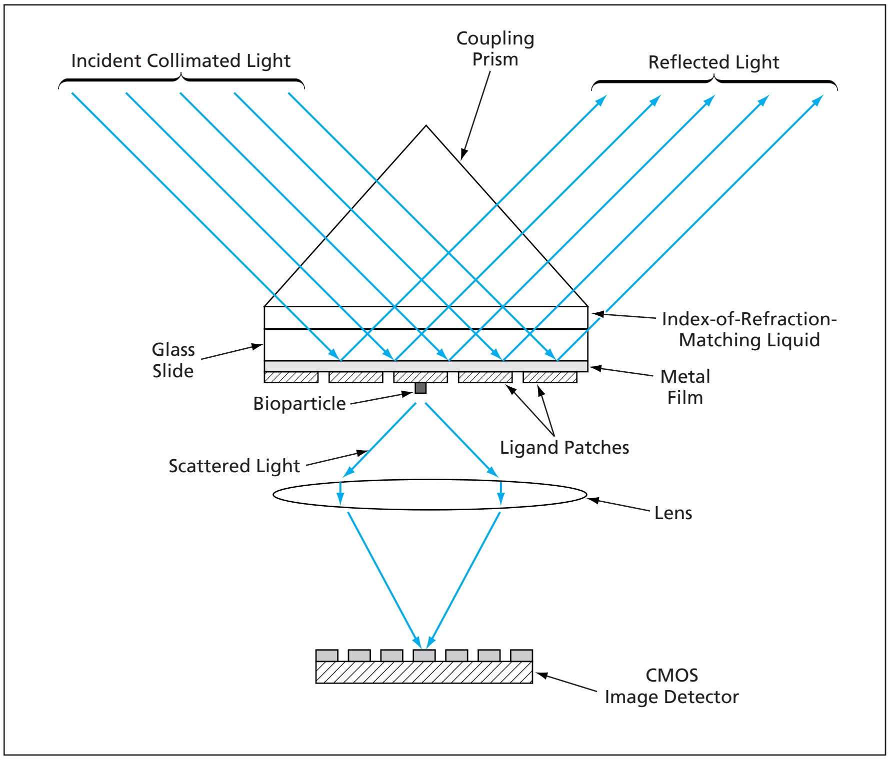

Light Scattered by SPR from a bioparticle/ligand binding site would be focused to a bright spot on an image detector.

binds analyte molecules. The gold film is thin enough to support evanescent-wave coupling through its thickness. The change in the effective index of refraction at the surface, and thus the change in the SPR response, increases with the number of bound analyte molecules. The device is illuminated at a fixed wavelength, and the intensity of light reflected from the gold surface opposite the ligand-coated surface is measured as a function of the angle of incidence. From these measurements, the angle of minimum reflection intensity is determined.

These measurements and the determination of the angle of minimum reflection intensity are performed before and after (and can be performed during) exposure of the sensor to a sample containing the analyte molecules. Any shift in the angle between such successive determinations is indicative of a change in the concentration of analyte molecules in the sample. This type of sensor is characterized by low sensitivity for the following reasons:

- A small number of analyte molecules gives rise to a small shift in the angle of minimum reflection intensity.
- Because one is measuring a reflection dip rather than a reflection peak, the measurement can be strongly affected by noise. The difficulty of determining the small angular shift is analogous to the difficulty of measuring the shift of a dark spot on a bright background.

A biosensor according to the proposal would afford a much greater signal-to-noise ratio by exploiting SPR in a different way that would involve, literally, a bright spot on a dark background. A proposed sensor (see figure) would include a coupling prism, an index-of-refraction-matching liquid, a glass slide, and a metal film thin enough to support evanescent-wave coupling. The metal surface to be exposed to the specimen would be coated with ligand in a regular array of patches. The array of patches would be observed by a miniature microscope that would include a lens and a complementary oxide/semiconductor (CMOS) image detector. The microscope would be designed so that each ligand patch would occupy many CMOS pixels and the resolution of the microscope would be close to the optical limit (about one wavelength of the incident light).

The sensor would be illuminated with collimated light at a wavelength and angle of incidence chosen so that SPR would occur whenever and wherever analyte molecules became bound to the ligand. In the absence of such binding, there would be little scattered light. In the presence of such binding at any spot on the ligand, the strong SPR scattering from that spot would cause the spot to be imaged brightly in the microscope. Even a bioparticle smaller than a wavelength of light could induce sufficient SPR scattering to be detectable.

This work was done by Yu Wang, Bedabrata Pain, Thomas Cunningham, and Suresh Seshadri of Caltech for **NASA's Jet Propulsion Laboratory**. *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:

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

Refer to NPO-40683, volume and number of this NASA Tech Briefs *issue, and the page number.*

Diode-Laser-Based Spectrometer for Sensing Gases

John H. Glenn Research Center, Cleveland, Ohio

A diode-laser-based spectrometer has been developed for measuring concentrations of gases and is intended particularly for use in analyzing and monitoring combustion processes under microgravitational conditions in a drop tower or a spacecraft. This instrument is also well suited for use on Earth in combustion experiments and for such related purposes as fire-safety monitoring and monitoring toxic and flammable gases in industrial settings.

Of the gas-sensing spectrometers available prior to the development of this instrument, those that were sensitive enough for measuring the combustion gases of interest were too large, required critical optical alignments, used far too much electrical power, and were insufficiently rugged for use under the severe conditions of spacecraft launch and space flight. In contrast, the present instrument is compact, consumes relatively little power, and is rugged enough to withstand launch vibrations and space flight. In addition, this instrument is characterized by long-term stability, accuracy, and reliability.

The diode laser in this spectrometer is operated in a wavelength-modulation mode. Different gases to be measured can be selected by changing modular laser units. The operation of the laser is controlled by customized, low-power electronic circuitry built around a digital signal-processor board. This customized circuitry also performs acquisition and analysis of data, controls communications, and manages errors.

This work was done by Joel A. Silver of Southwest Sciences, 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, Commercial Technology Office, Attn: Steve Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-17546-1.