AFM are separate instruments. Moreover, instead of using a special SERS-active AFM/spectrometer probe tip, one fabricates SERS-active regions at locations of interest on the specimen surface by using an AFM tip to deposit gold nanoparticles at those locations.

The first step is to image the specimen by use of the AFM to establish the locations of interest for high-resolution spectro-chemical analysis. Then SERS-active regions are fabricated at those locations by a form of dip-pen nanolithography: The AFM tip is dipped into a colloidal gold solution and used to deposit a single gold nanoparticle or a cluster of gold nanoparticles at each affected location (see figure). Then the AFM is disengaged, the deposited nanoparticles are illuminated in the spectrometer excitation beam, and the locally enhanced spectrum is acquired. Optionally, the AFM tip or the cantilever on which it is mounted can be moved above the deposited nanoparticles to modulate the light to enhance discrimination between the particle-enhanced components of the signal and the components from illuminated areas surrounding the particles.

This work was done by Mark S. Anderson of Caltech for NASA's Jet Propulsion Laboratory.

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
E-mail: iaoffice@jpl.nasa.gov

Refer to NPO-44033, volume and number of this NASA Tech Briefs *issue, and the page number.*

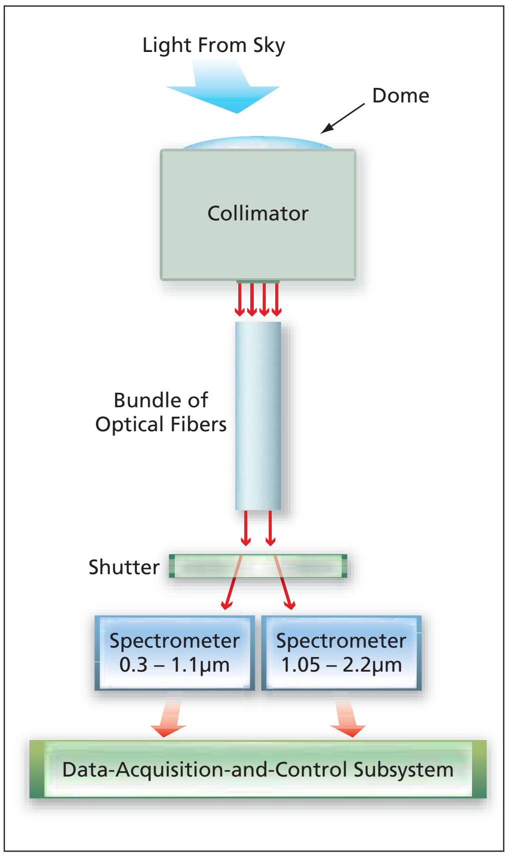
Light Collimator and Monitor for a Spectroradiometer

This system handles the optical input and electronic output of two spectrometers.

Ames Research Center, Moffett Field, California

A system that comprises optical and electronic subsystems has been developed as an infrastructure for a spectroradiometer that measures time-dependent spectral radiance of the daylight sky, in a narrow field of view (having angular width of the order of 1°) centered on the zenith, in several spectral bands in the wavelength range from 0.3 to 2.2 μm. This system is used in conjunction with two commercially available monolithic spectrometers: a silicon-based one for wavelengths from 0.3 to 1.1 μm and a gallium arsenide-based one for wavelengths from 1.05 to 2.2 μm (see figure). The role of this system is to collect the light from the affected region of the sky, collimate the light, deliver the collimated light to the monolithic spectrometers, and process the electronic outputs of the spectrometers.

This system includes a dome that faces the sky. Light collected via the dome passes through a collimator that has an aperture diameter ≈22 mm, a focal length ≈50 mm, and a field-of-view angular width that is adjustable between 1° and 2°. The collimated light enters a bundle of optical fibers that are chosen to have small numerical apertures so as to further limit the acceptance angle of received light. After propagating along the bundle of optical fibers, the light encounters a shutter that is operated on a controlled cycle, during which the shutter is alternately open for a time t_1, then closed for a time t_2. The cycle frequency can be 5 Hz or any suitable lower frequency; in practice, the cycle frequency (and, hence, the associated sampling frequency) is typically chosen to be 1 Hz.



The **Spectroradiometer** comprises optical and electronic subsystems that include two spectrometers operating in conjunction with the system described in the text.

When the shutter is open, light enters the monolithic spectrometer, electronic circuits in the spectrometers preprocess the outputs of photodetectors (one photodetector for each wavelength band), and the outputs of the spectrometer electronic circuits for the various wavelength ranges are sent to a data-acquisition-and-control subsystem that is part of the present system. When the shutter is closed, the same process takes place, for the purpose of collecting dark-current readings from the photodetector of each wavelength band.

The data-acquisition-and-control subsystem digitizes the spectrometer outputs and further processes them to generate any or all of a variety of useful output data. Among other things, this subsystem subtracts shutter-closed (dark-current) readings from shutter-open readings to obtain corrected spectral-radiance readings. In addition to alternately opening and closing the shutter and taking dark-current readings during the t_2 portions of successive cycles, the system can be made to sample dark currents during longer periods (e.g., a dark period of 5 minutes during each hour) to enable identification of anomalies in this system and/or in the spectrometers.

This work was done by Warren Gore of Ames Research Center.

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning rights for the commercial use of this invention should be addressed to the Ames Technology Partnerships Division at (650) 604-2954. Refer to ARC-15714-1.