

which can be larger than a signal from a very faint object transmitted through an open shutter. Since this situation can completely corrupt the results, it was necessary that the closed shutters be able to attenuate light by at least a factor of 2,000.

There currently exist four flight-quality microshutter arrays that have been fully or are currently undergoing testing and

the results support that the three improvements described above have successfully led to contrast levels >50,000 in over 99 percent of the microshutters at an operating temperature of 35 K. Applications for these high-contrast microshutters are in the photomask generation and stepper equipment used to make integrated circuits and microelectromechanical (MEMS) devices. Since microshutters are

a reconfigurable optical element, their versatility in these industries provides an improvement over printed masks and fixed projection alignment systems.

This work was done Murzy Jhabwala, Mary Li, Harvey Moseley, Dave Franz, Yun Zheng, and Alexander Kuttyrev of Goddard Space Flight Center. For further information, contact the Goddard Innovative Partnerships Office at (301) 286-5810. GSC-15609-1

Improved Scanners for Microscopic Hyperspectral Imaging

Neither specimens nor entire optical assemblies would be moved.

Stennis Space Center, Mississippi

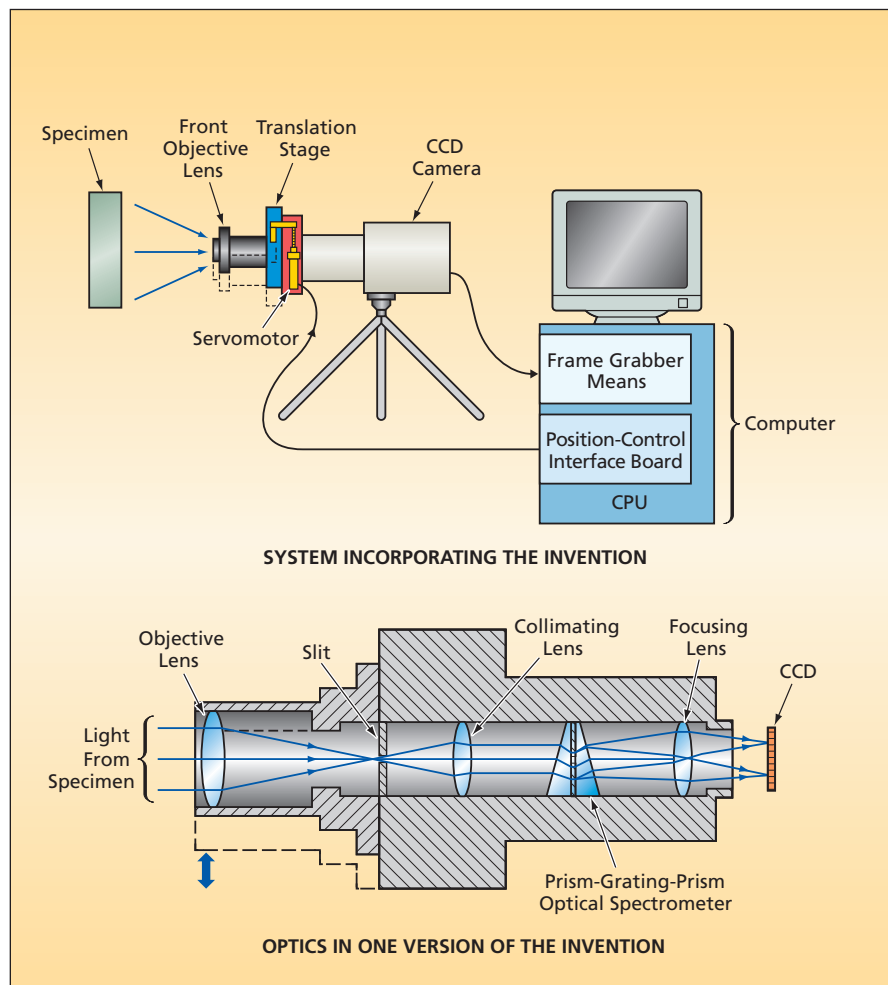
Improved scanners to be incorporated into hyperspectral microscope-based imaging systems have been invented. Heretofore, in microscopic imaging, including spectral imaging, it has been customary to either move the specimen relative to the optical assembly that includes the microscope or else

move the entire assembly relative to the specimen. It becomes extremely difficult to control such scanning when sub-micron translation increments are required, because the high magnification of the microscope enlarges all movements in the specimen image on the focal plane. To overcome this difficulty,

in a system based on this invention, no attempt would be made to move either the specimen or the optical assembly. Instead, an objective lens would be moved within the assembly so as to cause translation of the image at the focal plane: the effect would be equivalent to scanning in the focal plane.

The upper part of the figure depicts a generic proposed microscope-based hyperspectral imaging system incorporating the invention. The optical assembly of this system would include an objective lens (normally, a microscope objective lens) and a charge-coupled-device (CCD) camera. The objective lens would be mounted on a servomotor-driven translation stage, which would be capable of moving the lens in precisely controlled increments, relative to the camera, parallel to the focal-plane scan axis. The output of the CCD camera would be digitized and fed to a frame grabber in a computer. The computer would store the frame-grabber output for subsequent viewing and/or processing of images. The computer would contain a position-control interface board, through which it would control the servomotor.

There are several versions of the invention. An essential feature common to all versions is that the stationary optical subassembly containing the camera would also contain a spatial window, at the focal plane of the objective lens, that would pass only a selected portion of the image. In one version, the window would be a slit, the CCD would contain a one-dimensional array of pixels, and the objective lens would be moved along an axis perpendicular to the slit to spatially scan the image of the specimen in "pushbroom" fashion. The image built up by scanning in this case would be an ordinary (non-spectral) image.



The **Objective Lens Would Be Moved**, relative to the rest of the optical assembly, to scan the image in the focal plane.

In another version, the optics of which are depicted in the lower part of the figure, the spatial window would be a slit, the CCD would contain a two-dimensional array of pixels, the slit image would be refocused onto the CCD by a relay-lens pair consisting of a collimating and a focusing lens, and a prism-grating-prism optical spectrometer would be placed between the collimating and focusing lenses. Consequently, the image

on the CCD would be spatially resolved along the slit axis and spectrally resolved along the axis perpendicular to the slit. As in the first-mentioned version, the objective lens would be moved along an axis perpendicular to the slit to spatially scan the image of the specimen in "pushbroom" fashion.

This work was done by Chengye Mao of the Institute for Technology Development for Stennis Space Center.

Inquiries concerning this technology should be addressed to:

Chengye Mao

Institute for Technology Development

Building 1103, Suite 118

Stennis Space Center, MS 39529

Phone No.: (510) 353-9881

E-mail: chengye.geo@yahoo.com

Refer to SSC-00280-1, volume and number of this NASA Tech Briefs issue, and the page number.