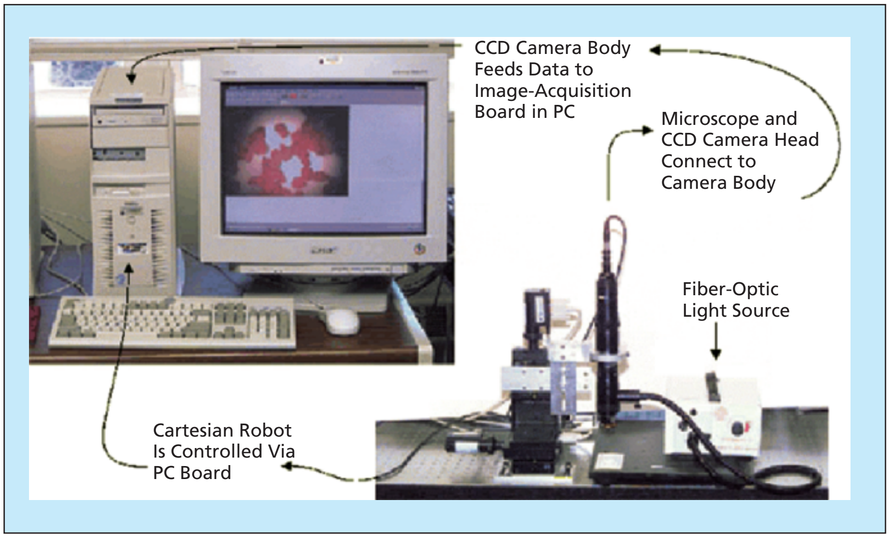

The **CMIS Takes Less Room** than does a conventional microscope. Unlike a conventional microscope, the CMIS offers capabilities for remote control and for automation of routine tasks.

quency content. The microscope position that results in the greatest dispersal of FFT content toward high spatial frequencies (indicating that the image shows the greatest amount of detail) is deemed to be the focal position.

In addition to automatic focusing, the machine-vision system is capable of performing the following other functions:

- *Adaptive Thresholding*: This function enables the choice of the best contrast needed for other image processing.
- *Auto-Imaging Scanning*: The microscope can scan along any or all of three Cartesian coordinate axes within a sample in order to find an object of interest.
- *Identification and Classification of Objects*: The system can find, classify, and label objects [e.g., living cells of one or more type(s) of interest] within a predetermined area of interest.
- *Motion Detection*: Movements of objects in a predetermined area of interest can be observed and quantified.
- *Transition Mapping*: In a sample containing small particles (e.g., colloids or living cells), small transitions between groups of particles can be detected. Examples of transitions include those between order and disorder, large and small objects, light and dark regions, and movement and non-movement. For example, in the case of a colloidal suspension containing a liquid and an adjacent solid phase, this function can be helpful in locating the zone of transition between the two phases.

This work was done by Mark McDowell of **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-17484.

Chirped-Superlattice, Blocked-Intersubband QWIP

Collection efficiency and, hence, quantum efficiency are expected to increase.

NASA's Jet Propulsion Laboratory, Pasadena, California

An $Al_xGa_{1-x}As/GaAs$ quantum-well infrared photodetector (QWIP) of the blocked-intersubband-detector (BID) type, now undergoing development, features a chirped (that is, aperiodic) superlattice. The purpose of the chirped superlattice is to increase the quantum efficiency of the device.

A somewhat lengthy background discussion is necessary to give meaning to a brief description of the present developmental QWIP. A BID QWIP was described in "MQW Based Block Intersubband Detector for Low-Background Operation" (NPO-21073), *NASA Tech Briefs* Vol. 25, No. 7 (July 2001), page 46. To recapitulate: The BID design was conceived in response to the deleterious effects of operation of a QWIP at low temperature under low background radiation. These effects can be summarized as a buildup of space charge and an associated high impedance and diminution of responsivity with increasing modulation frequency.

The BID design, which reduces these deleterious effects, calls for a heavily doped multiple-quantum-well (MQW) emitter section with barriers that are thinner than in prior MQW devices. The thinning of the barriers results in a large overlap of sublevel wave functions, thereby creating a miniband. Because of sequential resonant quantum-mechanical tunneling of electrons from the negative ohmic contact to and between wells, any space charge is quickly neutralized. At the same time, what would otherwise be a large component of dark current attributable to tunneling current through the whole device is suppressed by placing a relatively thick, undoped, impurity-free $Al_xGa_{1-x}As$ blocking barrier layer between the MQW emitter section and the positive ohmic contact. [This layer is similar to the thick, undoped $Al_xGa_{1-x}As$ layers used in photodetectors of the blocked-impurity-band (BIB) type.]

Notwithstanding the aforementioned advantage afforded by the BID design, the responsivity of a BID QWIP is very low because of low collection efficiency, which, in turn, is a result of low electrostatic-potential drop across the superlattice emitter. Because the emitter must be electrically conductive to prevent the buildup of space charge in depleted quantum wells, most of the externally applied bias voltage drop occurs across the blocking-barrier layer. This completes the background discussion.

In the developmental QWIP, the periodic superlattice of the prior BID design is to be replaced with the chirped superlattice, which is expected to provide a built-in electric field. As a result, the efficiency of collection of photoexcited charge carriers (and, hence, the net quantum efficiency and thus responsivity) should increase significantly.

This work was done by Sarath Gunapala, David Ting, and Sumith Bandara of Caltech for **NASA's Jet Propulsion Laboratory**. *Further information is contained in a TSP (see page 1).*
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