TECHNOLOGY

The moving laser writes . . .

A report from the San Jose Laboratories of International Business Machines Corp. indicates that scientists there have developed a terminal for an information-display system that uses a laser beam to write on a slide containing liquid-crystal material. A gallium-arsenide laser to do the writing and other things is being developed at IBM's Thomas J. Watson Research Center.

The laser is a chip 200 microns wide by 400 microns long. Its beam is directed by two computer-controlled oscillating mirrors that make the beam scan across a glass cell containing the liquid crystal material. The beam is turned on and off in a proper sequence to form written characters from spots in a grid nine spots high by seven spots wide. The images are then enlarged by a projection system. Color slides can be inserted into the terminal and projected onto the screen as overlays to material being typed at the terminal keyboard.

Normally the high viscosity of the liquid crystal will retain the images indefinitely, but application of an audio frequency voltage across the crystal will erase it. At the moment, the system writes at about 20 characters a second, fast enough to enter material from the keyboard, but not fast enough to display material stored in a computer. Ways to increase the speed are being studied.

More efficient solar cells

Another application of gallium arsenide is as a photovoltaic material in solar-energy cells. It converts sunlight falling on it directly to electricity. Solar cells are more commonly made of silicon, but gallium arsenide has two advantages: It will work at higher temperatures than silicon and therefore at higher concentrations of sunlight. It is theoretically a more efficient converter than silicon on the surface of the earth, and now, according to a report from IBM's Research Division at Yorktown Heights, N.Y., it is also more efficient in practice.

The best silicon cells, now widely used to power spacecraft, are 18 percent efficient for use on the ground. Up to now that number was also the best efficiency for gallium arsenide cells on the ground. Now, cells made by a new and rather simple technique, described in the May 2 APPLIED PHYSICS LETTERS by Jerry M. Woodall and Harry J. Hovel of IBM's Thomas J. Watson Research Center, reach an efficiency of 22 percent, much closer to the theoretical limit of 27 percent.

Because photovoltaic cells are likely to remain expensive no matter what they are made of, their use in ground-based installations (where size and weight are usually not the economically controlling factors) will depend on concentrating sunlight with lenses. Gallium arsenide seems a better bet for such use because it will stand the high temperatures.

New way to make semiconductors

Semiconductors have so many uses in modern electronic circuits that their manufacture is a big industry. The General Electric Co. believes that a new method of making them that has been developed at its Research and Development Center in Schenectady, N.Y., will afford important savings in time and energy.

To make a semiconductor useful in its electronic applications (in transistors for instance) a small amount of dopant (a particular foreign material) must be inserted into the pure crystal of semiconducting material. The new technique, thermomigration, uses a thermal gradient—heating one side of the crystal while keeping the other side cool—to make the dopant migrate through the crystal. This technique takes minutes, compared with older techniques that could take weeks and often results in breakage.

SPACE SCIENCES

Io: A surface of sulfur and salt

In 1975, Fraser P. Fanale, Douglas B. Nash and two other researchers from Jet Propulsion Laboratory reported that the sodium-rich spectra observed for Jupiter's moon Io could be traced to a surface mixture of 15 percent elemental sulfur and 85 percent of a mineral called blödite [$MgNa_2(SO_4)_2 \bullet X\ H_2O$]. Blödite, they said, "is one of only four 'salt' minerals that have been identified in meteorites, and the only sodium-rich one." Now, Fanale and Nash, aided by extensive laboratory spectra of test minerals, have refined those calculations. The result is that the surface of Io appears to be a sulfur miner's dream.

The laboratory studies, reported in ICARUS (31:40), were done on "a wide variety of evaporites, silicates, and elemental sulfur, as well as other mineral phases." The purpose was to determine their spectral reflectance properties as functions of composition, temperature, particle size, packing, multiphase mixing and proton-irradiation damage. The resulting spectra were compared with full-disk spectra of Io itself, in the range of 0.3 to 2.5 microns. The researchers also felt that, in order to be representative of the possible surface of Io, promising lab spectra would have to fit constraints imposed by certain other data, such as the presumed sodium enrichment (relative to cosmic abundances) of the non-free-sulfur component.

The laboratory mixture whose spectra best fit both the Io data and the other constraints consists of 55 percent (by volume) free sulfur, 30 percent dehydrated blödite, 15 percent ferric sulfate and trace amounts of hematite [Fe_2O_3]. Actually, the authors believe, free sulfur probably amounts to more than 60 percent—four times their 1975 estimate—of the material contributing to the full-disk spectra of Io.

The model also suggests that observed differences in spectral reflectance between the leading and trailing sides of Io may result from the trailing side being "richer in sulfur, drier, warmer, coarser-grained or more irradiation-damaged" than the leading side.

Mixing on Mars

One of the major findings of the two Viking landers on Mars was the discovery that the fine surface material at the two sites was almost uncannily similar in composition, despite differences in latitude, altitude, temperature, large-scale morphology and atmospheric water content. The suggested reason was that the material might be the result of planetwide weathering, in which the Martian winds both eroded the primary rocks and mixed up the resulting "fines" (SN: 10/16/76, p. 245). But how much of the surface, on this fine scale, is actually this homogeneous?

One help in finding out is a series of reflectance spectra, taken in 1973 when Mars was close to the earth, in order to look for global patterns that can be related to composition and mineralogy. Three different methods were used by Thomas B. McCord and colleagues from the Massachusetts Institute of Technology. Results from one—photoelectric filter photometry from 0.33 to 1.10 microns—are reported in ICARUS (31:25). Four reflectance regimes were isolated: bright areas, dust clouds, dark areas and mixed or intermediate areas.

The bright areas and dust clouds may all be composed of a similar mineralogical unit, the authors report, judging from a shared intense blue-ultraviolet absorption feature and a weak infrared one. The dark area soils apparently differ substantially from the high-albedo dust in mineralogy, probably due to differences in chemical weathering. The bright and dust spectra show no regional variations, but clear differences show within the dark areas. Compositional interpretations and results from the other techniques will follow.