# Technology

*Ivars Peterson reports from Albuquerque, N.M., at the spring meeting of the Materials Research Society*

## Ceramics for storing photographs

A piece of photographic film captures an image permanently, but for many applications this permanence is a disadvantage. Thus, for years, researchers have been trying to develop an erasable and reusable material for temporarily storing optical images. One promising candidate is a transparent ceramic made from lanthanum mixed with lead zirconate and lead titanate.

The storage of images in thin plates of this ceramic (PLZT) material involves exposing one face of a plate to ultraviolet light while an electric field is applied at the same time within the ceramic. The resulting stored image achieves a high resolution, shows high contrast and faithfully reproduces shades of gray. In the absence of an applied electric field, an image remains permanently stored in the ceramic. After storage, however, the image can be totally or selectively erased by applying appropriate electric fields. The image can also be switched electrically from positive to negative or partially switched to enhance the contrast of areas of the image stored at low exposure levels.

Recently, researchers at the Sandia National Laboratories in Albuquerque, N.M., where PLZT ceramics were invented, improved the sensitivity of these ceramic plates to light. By implanting helium, neon or argon ions into a thin layer on a plate's upper surface, Cecil E. Land and Paul S. Peercy increased the material's ultraviolet photosensitivity by a factor of 10,000. By implanting these ions together with chemically active aluminum or chromium ions, they also extended the material's response into the visible light region of the spectrum. Now, even sunlight or an incandescent lamp can produce an image.

The researchers note that "the dramatic increase in the photosensitivity" of the material greatly expands its potential uses as an erasable, reusable optical image storage medium. These applications include previewing positives of negatives before conventional photographic printing, as a negative for multiple prints or copies, for optical processing to improve contrast, and because the images can be read either electrically or optically, for facsimile transmission and reception.

The chief problem in working with PLZT ceramics has been their costliness. However, that is changing. Researchers at the Matsushita Electric Co. in Osaka, Japan, reported an improved method for making large plates (up to 10 inches long) of these ceramics. Their fabrication process lends itself to mass production and significantly reduces the cost of the product.

## Color printing by ink drops

The race to produce a high-resolution, full-color printer that is economical and reliable enough to use with a personal computer has prompted a great deal of research on "drop-on-demand" ink-jet printing. Conventional ink-jet printers currently in use produce a steady stream of ink droplets. Some of these droplets are electrostatically attracted to a paper surface to form printed characters from an array of dots, while the bulk of the ink is recirculated. In the newer, "drop-on-demand" technology, high-frequency impulses force the ejection of ink drops only when the ink is needed. This greatly simplifies the printer's inner workings, and with the use of four separate ink cartridges (for cyan, magenta, yellow and black ink) and an array of nozzles, it also allows the possibility of full-color printing.

Nevertheless, technical difficulties remain. The frequency at which drops are ejected in a regular pattern has an upper limit. To achieve rapid, high-resolution color printing that packs 240 dots into an inch of space, a large array of nozzles must be used. Recently, researchers at NEC in Japan designed a 96-nozzle head that shows promise. However, print quality is still uneven because of variations in drop size and errors in paper feeding and positioning. Although a few companies are already marketing low-resolution "drop-on-demand" ink-jet printers, commercial, high-resolution printers are still several years away.

# Earth Sciences

## Helping pilots avoid volcanic clouds

The gritty debris emitted during volcanic eruptions may be unpleasant for earth-bound observers, but aircraft too can choke on the particles. Twice in 1982, Boeing 747s cruising 30,000 feet over Indonesia unknowingly flew into dust clouds from the erupting volcano Galunggung, causing the jet engines to stall. In each case, the pilot managed to restart the plane at a lower altitude, averting catastrophe, but the near-misses have prompted an investigation by the National Aeronautics and Space Administration and the Federal Aviation Administration (FAA) into ways of monitoring volcanic activity from space.

One monitoring approach being evaluated stems from a fortuitous discovery shortly after the 1981 eruption of El Chichón in Mexico (SN: 8/21/82, p. 120). The NASA satellite Nimbus 7 carries an instrument called a Total Ozone Mapping Spectrometer, or TOMS, which measures ozone by looking at the brightness of the earth's atmosphere in the ultraviolet bands of the light spectrum. At the time the researchers noticed a strange signal in their ozone data, they were unaware that the massive eruption had occurred. The abundant sulfur dioxide ($SO_2$) particles in the volcanic debris absorb light at a different wavelength than ozone. The $SO_2$ light absorption skewed the ozone measurements but also enabled the researchers to track the dust cloud's movements. Since then, says Arlin Kruger of NASA's Goddard Space Flight Center, "We have developed a way to discriminate between ozone absorption and $SO_2$ absorption."

The NASA researchers tested their method by looking back at the last few years of TOMS data; all of the major volcanic eruptions can be detected, as well as eruptions at small volcanoes. "Until now there was never a way to unambiguously detect volcanic eruptions from space," Kruger says.

Another option being studied is placement of a special instrument aboard the National Oceanic and Atmospheric Administration's geostationary satellite (GOES). Presently the two GOES satellites can recognize the shape of a volcanic plume, which is a less reliable signal than the sulfur dioxide. An advantage of using the GOES satellites is that they simply stare at the earth from their relatively fixed positions, whereas the Nimbus 7 sees each point on the earth only once a day, at local noon. Thus, it could be nearly a day until an eruption is recorded and pilots notified of its whereabouts.

## In 1983, more quakes, but fewer deaths

Seventy significant earthquakes Richter magnitude 6.5 or greater rattled the planet in 1983, but one-third fewer people died than in 1982, when 56 such quakes occurred, the United States Geological Survey (USGS) reports. Waverly J. Person of USGS in Golden, Colo., said that 14 quakes in 1983 were major quakes (magnitude 7.0 to 7.9) compared to 10 for the previous year. The long-term average for major quakes is 18 per year. During the last century, an average of about one great quake occurs each year, but none has occurred since July 1980 when the Santa Cruz islands in the South Pacific suffered a "great" shock with a magnitude of about 8.0.

## Nations sign up for ocean drilling

The long-planned Ocean Drilling Program took another step toward realization this week as the United States, France, West Germany and the European Science Foundation signed Memoranda of Understanding regarding their participation in the international ocean-floor drilling project. The program is scheduled to begin in October, with major funding from the U.S. National Science Foundation. The *Sedco-BP* 471 is being outfitted as the drilling ship for the program, and will replace the *Glomar Challenger,* which was retired last year from its role as the drillship for the now-defunct Deep Sea Drilling Project.