AT&T INNOVATION BRIEFS

Innovation Briefs are summaries of recent discoveries and developments within Bell Labs. AT&T readers who would like to contribute future items are encouraged to contact the Technical Journal editor.

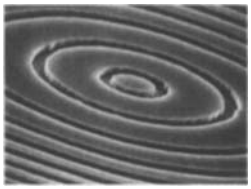
Sending Speech and Data Over Voice-Band Channels

One of the goals of personal communications systems is the ability to send both voice and data over standard voice-band channels. This will permit handwritten information (scribbling) to be transmitted, simultaneously, along with voice signals. Drawbacks have been that some of the more obvious methods of achieving the dual transmission also result in irregular delays in the signals, or degradation of the voice quality. Recently, however, Bell Labs researchers have devised a method—superimposing the analog voice signal directly on the modem signal constellation—that overcomes these drawbacks. After error protection, binary pulse amplitude-modulated data is added directly to 4-kilohertz band-limited speech. At the receiver, after channel equalization, the data is recovered by treating the speech as an additive signal generated using a linear predictive model. Once the data is recovered, the speech is obtained by re-encoding the recovered data, with the same channel encoder used at the transmitter, and then subtracting that data from the received signal. Excellent speech quality and data rates of 1 to 2 kbits/s have been achieved with acceptably low bit-error rates.

Improved Synthesis of Electroluminescent Polymers

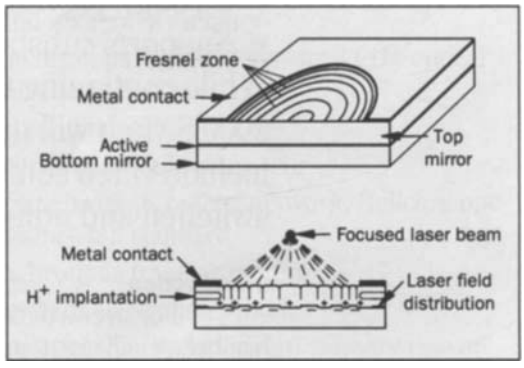
As devices that contain display screens become smaller and more mobile, there's an increasing need to replace the fluorescent lamps that backlight the displays with alternative luminescent devices that consume less power and produce less heat. Films made of thin, electroluminescent polymers are good candidates to replace the lamps, if their efficiency and life span can be improved. Bell Labs researchers have developed a proprietary process that significantly improves the efficiency of one synthetic polymer—poly-phenylene vinylene, or PPV. They found that PPV processed in air contains large amounts of intermolecular chemical defects. But, if synthesized in an atmosphere of 99.9 percent inert gas, or in a reducing atmosphere in which oxygen is removed, the resulting materials show an increase in photoluminescence of almost an order of magnitude. Using an aluminum-magnesium electrode, efficiencies of up to 1 percent have been achieved. Previously, such efficiencies have only been achieved using calcium electrodes, which are much more unstable and reactive. Work is also beginning on the synthesis of the thienylene analog of PPV, which has been reported in Japan to be a promising candidate for thin-film transistors in liquid-crystal display applications.

First Self-Focusing Laser Structures



The structure of zone lasers consists of optical zones separated by reactive ion-etched trenches one micron wide and about 0.35 micron deep.

Bell Labs researchers have recently built the world's first self-focusing lasers. Called zone lasers, or Z-lasers, the devices need no lenses to focus their light on a specific point. The result of a unique design and special processing, the new laser's output light converges in a way that's not possible with conventional lasers. Z-lasers make use of vertical-cavity geometry to emit light vertically from their surfaces. This contrasts with conventional lasers, which emit light horizontally from their edges. A new class of structure, the Z-laser is made of layers of indium gallium arsenide, gallium arsenide and aluminum gallium arsenide. The layers are fabricated using molecular beam epitaxy (MBE), a technique that was invented and developed at Bell Labs. (Bell Labs scientist Alfred Y. Cho recently received the National Medal of Science from President Clinton for his work toward the invention and development of MBE.) With MBE, precisely controlled layers of various materials—as thin as a single atom—are deposited on top of one another, forming ultra-thin films that are a basis for many semiconductor devices. The new class of vertical cavity lasers operates at high power and high efficiency, and covers a large (70-μm-diameter) area. The light output is automatically focused on a spot at a particular distance from the laser. Although they are still experimental devices, Z-lasers have important implications for applications in telecommunications, computers, and consumer electronics.



The zone laser is a temporally/spatially coherent vertical-cavity device with an output beam that focuses to a spot without the use of external binary grating or lenses.