ODS '91: Colorado Springs

Progress in capacity, cost/byte critical for optical data storage

BY DONALD B. CARLIN AND DAVID B. KAY

If optical data storage is to make further inroads in meeting the digital data storage needs that may also be satisfied by ongoing improvements in magnetic recording, continued performance enhancement and reduced cost/byte stored is essential. That was the message that keynote speaker Vic Jipson of IBM Almaden Research Center brought to the 1991 Topical Meeting on Optical Data Storage held in Colorado Springs, February 25-27.

According to Jipson, potential improvements that could be implemented in practical systems include the development of improved actuators, directly overwritable (DOW) disks, advanced data channels, parallel read/write channels, and shorter wavelengths lasers, all of which have been demonstrated. He indicated that optical data storage either will need to double media capacity every three years with fixed media and hardware costs, or use a combination of increased capacity and reduced hardware costs to remain viable. Up to a factor of 30 improvement in data density is achievable, Jipson concluded.

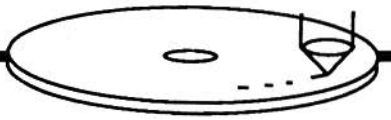
Bill Lenth, also of IBM Almaden, sparked great interest in his talk on coherent generation of blue light by frequency doubling—with 54 mW cw was generated at 428 nm by doubling the light of a 125 mW AlGaAs diode laser in $KNbO_3$. Efforts are underway to obtain high-power frequency doubling in KTP waveguides at 497 nm, as this material has a much broader temperature range over which phase matching occurs. Richard Craig of Spectra Diode Laboratories discussed 2-, 9-, and 18-element AlGaAs arrays, aimed at parallel channel recording. Some of these were being made at wavelengths appropriate for doubling in $KNbO_3$.

SONY reported a breakthrough in MO technology that promises to increase recording density by two to six times over conventional means. In one approach, the medium consists of a low coercivity recording layer and a high coercivity readout layer exchange-coupled together. Before reading, the magnetic moments in the readout layer are aligned by an external magnetic field and contain no information. The readout laser beam heats that layer and lowers its coercivity so that the exchange force copies the information from the recording layer to the readout layer. Only the hottest part of the medium under the read laser beam contains this information to be retrieved; the effective resolution exceeds the diffraction limit of the optical head. Using this technique, a 13-cm disk can potentially store over 2 GB of information using a diode laser source.

Sadik Esener of the University of California at San Diego discussed two photon 3-D optical memories, using two beams of differing wavelength coincident upon a volumetric storage medium by use of two-photon absorption processes. One beam was used to project a pattern of two-dimensional information generated by a spatial light modulator and the other beam was used to select a plane within the medium. Feasibility was demonstrated in a photochromic molecule of spirobenzopyran in PMMA.

Direct overwrite was the main focus of the papers on erasable media. In a session on magneto-optic DOW, three papers addressed exchange-coupled multilayer (ECML) magnetic media and emphasized the advantages of this scheme over alternatives. Based on the data presented for actual disks, it appears that ECML media can deliver high carrier-to-noise and reliable performance characteristics. Four papers were presented on phase-change technology. Ohta, from Matsushita Electric, reported over two million direct overwrite cycles.

A recurring theme was that of replacing individual components in recording heads that reduce in size, mass, or cost, or which improve system performance. Examples included the use of polarization-preserving optical fibers (Carnegie Mellon University) to significantly reduce the moving mass of the head, achromatized prism



beam expanders (Eastman Kodak) to reduce jitter in the data signal, and a compact magneto-optic head (NEC).

Flying head papers dominated the session on heads. Yasukawa and colleagues of Fuji Xerox described a magneto-optic split-head architecture using flying lens, in a slider, with an average seek time of 10 ms on a 90 nm disk. Renard and Valette of LETI, Grenoble, described an integrated magneto-optic head (IMOH) in the early stages of development that uses integrated optics on a silicon substrate with an integrated thin film magnetic coil for field modulation. Ukita and co-workers at NTT reported their continuing progress on a flying laser diode-photodiode (LP-PD) slider with more than 5×10^4 contact starts/stops and a head lifetime of more than 2,000 hours.

In aerospace applications, optical disk technology has transcended even the most optimistic predictions for success. Fred Haritatos of Rome Laboratory discussed the development and flight test of a 13-cm Tactical Optical Disk System (MO erasable system) in an F-16 aircraft operating through 9.5 G turns. An update on the 35-cm format TODS system, which uses a dual diode array to achieve 25-50 Mbps throughput with 6 GB per disk surface, was given by GE Aerospace.

ODS '91, co-sponsored by OSA, IEEE/LEOS, and SPIE, clearly demonstrated that significant technical progress is being made both in the engineering of conventional optical data storage system for commercial use and in novel concepts aimed at vastly improving the capabilities of the technology for the future.

Moreover, the meeting was a technical success even though most Japanese speakers were unable to attend due to the Persian Gulf War. Those who could not attend either sent alternate American-based corporate representatives to read their manuscripts or sent videotapes of their presentations. The quantity of exchange of technical information was thus largely preserved under these unusual circumstances. Continued advances will be reported at the 1992 Optical Data Storage Topical Meeting, set for Feb. 10-13 in San Jose.

Donald B. Carlin and David B. Kay, *program chairs, 1991 Optical Data Storage Topical Meeting.*

Coherent Laser Radar *(continued from page 29)*

spectral region around 1-2 μm, as sources for coherent laser systems. Diode-pumped solid state lasers offer the potential of good reliability and compactness, and also can provide measurements with higher spatial resolution than equivalent lidar systems operating near 10 μm. However, CO_2 lasers still are being used in small systems for atmospheric studies and imaging. Current work is focussed on applying radio-frequency excited laser technology to produce compact, high pulse-repetition rate lasers with pulse energies of several tens of mJ.

OSA's Topical Meeting on Coherent Laser Radar: Technology and Applications covers two main topics: (1) advances in coherent lidar instrumentation, including laser sources, system design, components, space-based lidar development, testing and calibration, and signal processing; and (2) examples of the use of coherent lidar, such as global wind measurement, wind shear and wake vortex detection, studies of atmospheric wind flow and cloud properties, aerosol measurements, and object imaging and tracking. Panel discussions on selected topics of interest are planned for two evenings during the conference.

The meeting will be of particular relevance to scientists interested in developing new coherent lidars or applying them for both environmental research and military applications. Several overview talks from program managers at federal agencies will address future activities where coherent lidar is expected to play a lead role. NASA is providing partial support for the meeting.

R. Michael Hardesty of the NOAA Wave Propagation Laboratory is program chair and Pierre Flamant of the Laboratorie de Meterologie Dynamique in France is program co-chair.

— R. Michael Hardesty