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SAN DIEGO ROOM

8:30 AM **Optical Communications: 1**
H. F. Lockwood, Presider

TUAA3 V-groove $Ga_xAl_{1-x}As$ DHS injection laser as a fiber-optic transmitter

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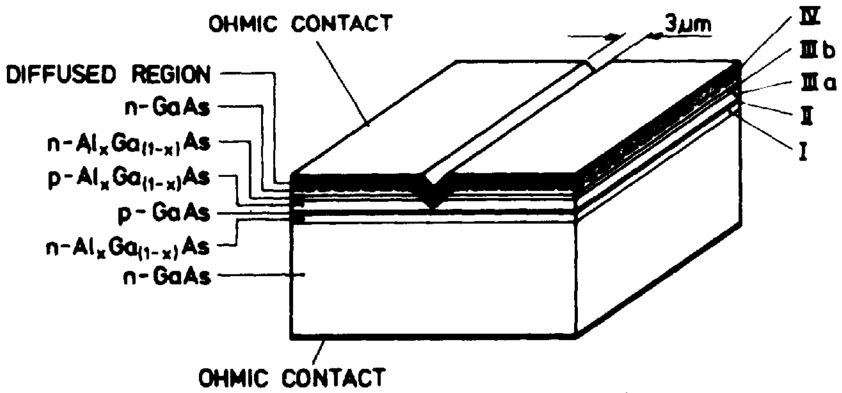
The V-groove laser is an easily fabricated diffusion-type stripe-geometry injection laser. Absence of kinks up to high output power (25 mW/mirror), low degradation rate, excellent linearity, and stable operation in the fundamental transverse mode are essential prerequisites for application as a fiber-optic transmitter.

The laser structure is of the type presented by Marschall *et al.*[1]; see Fig. 1. The layers are grown by liquid-phase epitaxy on a (100) GaAs substrate. In a second step, narrow V-grooves are etched through a mask of photoresist into the cap layer. The *n*-GaAlAs layer is converted to *p*-type with a shallow Zn diffusion below the V-groove only. In this way a narrow conducting path ~3 μm wide is formed below the V-groove. The structure exhibits no refractive-index variation in the plane of the active layer. Waveguiding within the junction plane is accomplished by gain confinement.

V-groove laser diodes exhibit linear light output vs current up to the catastrophic damage level. In cw operation at least 25-mW light power per facet were obtained without kinks. In pulsed operation no kinks were observed up to several hundreds of milliwatts. Threshold currents lie between 80 and 120 mA for 400-μm laser length and near 50 mA for 200-μm laser length. The spectrum exhibits several longitudinal modes and has a halfwidth of typically 2 nm. The multilongitudinal-mode spectrum is characteristic of lasers with gain-guiding structures, whereas index-guiding structures tend to oscillate in a single longitudinal mode.[2] On the other hand, lasers with gain guiding—such as the V-groove laser—are far superior with respect to excess noise around threshold[3,4] and to insensitivity against optical feedback. The direct PCM modulation capability reaches up to 1 Gbit/sec.[5] The high linearity and the high SNR also make the V-groove laser well suited for analog applications.

The degradation rate D was determined from lifetime tests at 70°C. We define D as the relative increase of the laser current per unit of time for constant 5-mW cw emission per facet. The degradation rates decrease with increasing operating time; a few percent per 100 h were achieved. Assuming 0.7–0.9-V activation energy,[6] lifetimes between 10^5 and 10^6 h were estimated for room-temperature operation. **(13 min)**



TUAA3 Fig. 1. V-groove laser structure.

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2. K. Petermann, IEEE J. Quantum Electron. **QE-15,** 566 (1979).
3. G. Arnold, F. J. Berlec, and K. Petermann, "Quantum noise of semiconductor injection lasers in optical fibre communication systems," in *Proceedings, Fifth European Conference on Optical Communication, Amsterdam, 17–19 Sept. 1979* (to be published).
4. G. Arnold and K. Petermann, to be published.
5. J. Gruber, M. Holz, P. Marten, R. Petschacher, P. Russer, and E. Weidel, "A 1 Gbit/s fibre optic communications link," in *Proceedings, Fourth European Conference on Optical Communication, Genova, 12–15 Sept. 1978,* pp. 556–563.
6. M. Ettenberg, H. Kressel, and I. Ladany, Electron. Lett. **14,** 815 (1978).