

ION IMPLANTATION OF Ti INTO LiNbO_3 :
FABRICATION OF WAVEGUIDES AND SIMPLE MODULATORS*

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Ion implantation has been used to introduce Ti at very high doses ($>3 \times 10^{17}/\text{cm}^2$) into the near-surface region of LiNbO_3 to change the index of refraction.¹ In the as-implanted state, the near surface is amorphous. Thermal annealing in water-saturated oxygen at 1000°C crystallizes the amorphous region and incorporates the Ti into substitutional sites in the lattice at concentrations that exceed 10 at.%. Recrystallization takes place by solid-phase epitaxy.^{1,2} Both planar and channel waveguides have been fabricated with optical attenuations of <1 dB/cm.^{3,4} Both Mach-Zehnder and Bragg modulators have been fabricated using Ti implantation of LiNbO_3 .^{3,4} The characteristics of these devices have been determined and will be reported. The higher Ti concentrations which can be achieved by implantation allows tighter mode confinement and smaller mode profiles than with Ti-diffused guides.

¹ C. Buchal, P. R. Ashley, and B. R. Appleton, *J. Mater. Res.* **2**, 222 (1987).

² D. B. Poker and D. K. Thomas, *J. Mater. Res.* (in press).

³ P. R. Ashley and C. Buchal, *SPIE Proceedings* **21**, 113 (1987).

⁴ P. R. Ashley et al., submitted to *IEEE Lightwave Technology*.

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