Ti-diffused $LiNbO_3$ optical waveguides with low loss

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The fabrication and performance of optical waveguides by the in-diffusion of titanium into $LiNbO_3$ were investigated. We employ a closed-tube diffusion system and a method to supply Li. The $LiNbO_3$ powder which has the same stoichiometry as the sample substrate and the Ti-sputtered $LiNbO_3$ wafer were placed in closed rectangular ($77\times23\times21$ mm^3) white alundum boat. For most of the experiments, fresh $LiNbO_3$ powder (0.5g) was used each time. Titanium films were deposited onto y-cut $LiNbO_3$ substrates by RF sputtering from a high-purity (99.99%) titanium. Under the diffusion conditions of time (8hr) and temperature (1000°C), we have found that it is possible to obtain single-mode waveguides (at 6328 Å), for Ti-films ranging in thickness between 192 and 460 Å. The fabrication of waveguides is very simple and reproducible and it is possible both to suppress Li_2O out-diffusion and to obtain the waveguides with low loss (~1 db/cm). Hence this technology is reasonable.

Under the conditions of suppressing Li_2O out-diffusion, the characteristics and parameters of the optical waveguides (such as mode index n_m, maximum index change Δn_s, diffusion depth d, diffusion constant D) have been measured and calculated by using the secant hyperbolic profile (zero order perturbation) and parabolic approximation respectively, which have not been reported yet.

低损耗 Ti 扩散 $LiNbO_3$ 光波导

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本文对钛内扩散 $LiNbO_3$ 光波导的制备和性能进行了研究。我们采用闭管扩散工艺和补 Li 措施，密闭长方形($77\times23\times21$ mm^3)白刚玉舟内放有与样品衬底相同化学配比的 $LiNbO_3$ 粉和溅射过 Ti 的 $LiNbO_3$ 片子，多数实验每次用新的 $LiNbO_3$ 粉 0.5 克。由高频溅射高纯(99.99%)钛的办法，在 y—切 $LiNbO_3$ 衬底上淀积钛膜，在温度为 1000°C，时间为八小时的扩散条件下发现，Ti 膜厚度在 192–460 Å 范围内，可获得单模波导(6328 Å)。这种工艺使波导的制作十分简单，重复性好，而且既可抑制 Li_2O 外扩散，又可获得低损耗(~1 db/cm)光波导，因此这种工艺是合理的。

在抑制 Li_2O 外扩散的条件下，分别用抛物线近似和双曲线正割分布(零级近似)，对光波导的特性和参数(如模折射率 n_m、最大折射率改变 Δn_s、扩散深度 d、扩散常数 D)进行了测量和计算，而这些还没有见过报导。