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Fabrication and optimisation of waveguides in lithium niobate by differential etching following spatially selective domain inversion

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Lithium niobate is extensively used in a wide range of applications, due to its favourable electro-optic, acousto-optic, piezoelectric, elastic and photorefractive properties. The ability to engineer precisely controlled and very smooth structures has applications in lateral guidance such as waveguides and modulators, for multiple arrays in photonic bandgap structures and for surface acoustic wave devices such as filters and time delays.

Techniques reported to date for microstructuring lithium niobate include reactive ion etching, reactive ion beam etching, laser ablation, above and below bandgap, laser assisted chemical etching using chlorine and potassium fluoride and wet-etching of structures defined by proton exchange. Many of these techniques however cannot penetrate the substrate to distances more than a few microns, thus limiting the maximum aspect ratio of structures produced.

The domain etching technique here defines the desired structures by electric field inversion of the ferroelectric domains of lithium niobate. These domains extend *throughout* the crystal enabling structures to be fabricated to depths >100 microns and large aspect ratios. Additionally the process is a manipulation of the crystal structure at the unit cell level, thus enabling the production of smooth walls, as our scanning electron microscope images show.

These characteristics [1] offer distinct advantages for production of ridge waveguides, especially in the design of travelling wave electrode modulators [2]. Here fibre alignment grooves can be defined and formed, potentially during the same process stages as ridge waveguides. This minimises coupling losses and maximises modulator performance in a one-step procedure. We will report waveguide performance, loss measurements, and the use of this technique in lithium niobate doped with iron and rare earths.

References

[1] I.E.Barry, G.W.Ross, P.G.R.Smith, R.W.Eason, G.Cook, 'Microstructuring of lithium niobate using differential etch-rate between inverted and non-inverted ferroelectric domains', Mat. Letts., submitted Dec.1997.

[2] R.S.Cheng, W.L.Chen, W.S.Wang, IEEE Phot.Techn.Letts. 7, 1282, (1995).