# Surface Domain Inversion in $LiNbO_3$ by Direct UV Writing

T. JUNGK[1], Á. HOFFMANN[1], E. SOERGEL[1*], S. MAILIS[2], A. C. MUIR[2], I. T. WELLINGTON[2], C. E. VALDIVIA[2], C. L. SONES[2], AND R. W. EASON[2]

[1]*Institute of Physics, University of Bonn, Wegelerstraße 8, 53115 Bonn, Germany*
[2]*Optoelectronics Research Centre, University of Southampton, Highfield, Southampton SO17 1BJ, UK*
**E-mail address: soergel@uni-bonn.de*

Ferroelectric domain inversion has been achieved on the +z and the −z faces of congruent undoped lithium niobate ($LiNbO_3$) single crystals by direct UV writing using a continuous wave (c.w.) frequency doubled argon ion laser ($\lambda = 244$ nm). The width and the depth of the domains were observed to depend on the intensity and the spot size of the laser beam as well as the writing speed. The inverted domain structures were investigated by scanning electron microscopy (SEM), after HF acid differential etching, and piezoresponse force microscopy (PFM) [1]. UV laser inverted domains directly written on a multi domain crystal (PPLN) show that the PFM contrast of the UV written domains is lower as compared to the bulk domains (Fig. 1b). This indicates that the UV written domains are shallower than 1 µm because any domain depth exceeding ~ 1 µm in $LiNbO_3$ would appear as bulk in PFM imaging. This is consistent with the extremely small absorption depth of << 1 µm at $\lambda = 244$ nm [2].

Although shallow these UV laser written domains can be also remarkably narrow and also they can be fabricated onto any surface independent of the crystal orientation. Driving these surface domains deeper in the crystal by optical or electric field post processing. is currently under investigation.

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(a) (b)

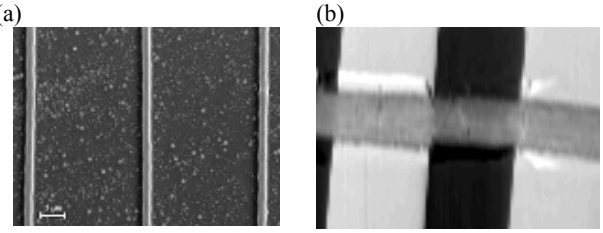

Fig. 1: (a) Scanning electron microscopy image of the HF etched UV laser inverted domain lines. (b) Piezoresponse force microscopy image of UV-induced domain structures written on a previously periodically poled $LiNbO_3$ substrate ($\Lambda = 8$ µm). The relative contrast indicates that the depth of the UV-written domains is << 1 µm..

[1] T. Jungk, Á. Hoffmann, and E. Soergel, Appl. Phys. Lett. 89, 163507 (2006).
[2] A. C. Muir, G. J. Daniell, C. P. Please, I. T. Wellington, S. Mailis, R. W. Eason, Appl. Phys. A, 83, 389 (2006)