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QUASI-PHASE-MATCHING LITHIUM NIOBATE, PERIODICALLY POLED VIA LIQUID ELECTRODES

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We have achieved reliable periodic poling of z-cut lithium niobate in 0.2 mm thick samples, patterned with photoresist on one face and subjected to pulsed electric fields via liquid electrodes. Our set-up was a further development of the one used by Camlibel [1]. Filter paper was soaked in a solution of LiCl in water and placed on both sides of a sample with a photoresist pattern on one side (1 micrometre of standard photoresist acts as an effective barrier to domain inversion). This sandwich was then clamped between electrodes connected to ground and a high-voltage pulse generator. The pulse amplitude was 4.5 kV. We found that the single most important feature during inversion is that the transferred charge should be twice the spontaneous polarization times the desired area of inversion. The domains went all the way through the substrate, with a slight random variation in the position of the domain walls on the planar electrode side.

Our best optical results to date were obtained in a 0.2 mm thick sample with a period of 9 μm (average domain width 4.5 μm), designed to give third order quasi-phase-matching at 0.83 μm. The crystal length was 3.3 mm. A tunable Ti:sapphire laser was used in the experiments with a waist spot size inside the crystal of w_0 = 18 μm. The SH output was proportional to the square of the input all the way up to an output of 20 μW for an input of 300 mW, indicating that photorefractive damage was not a problem.

The phase-matching peak had the bandwidth predicted by theory, sightly less than 0.2 nm, demonstrating that the full length of the crystal was involved in the interaction. The conversion efficiency 0.07 %/Wcm was about ten times smaller than the theoretical value for a perfectly periodic crystal. This we attribute to the random deviation of the domain wall position.

1. I. Camlibel, "Spontaneous polarization measurements in several ferroelectric oxides using a pulsed-field method", *J.Appl.Phys.*, 1969, 40, pp.1690-1693.

2. W.K. Burns, W. McElhanon, and L. Goldberg, "Second harmonic generation in field poled, quasi-phase-matched, bulk $LiNbO_3$", Conference on Blue-Green Lasers, *OSA 1994 Tech. Dig. Ser. Vol.1*, pp.38-40.

3. J. Webjörn, V. Pruneri, P.St.J. Russell, J.R.M. Barr, and D.C. Hanna, "Quasi-phase-matched blue light generation in bulk lithium niobate, electrically poled via periodic liquid electrodes", *Electronics Letters*, 1994.