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INVESTIGATION OF OPTICAL PERIODIC POLING TECHNIQUES IN STRONTIUM BARIUM NIOBATE (SBN)

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Periodic Poling of nonlinear optical materials into spatially alternating domain structures, is a successful method of achieving quasi-phase-matching in materials that are not readily phase-matched via conventional birefringent techniques. Of particular interest to the optics community are ferroelectric materials such as $LiNbO_3$[1] that possess large nonlinear optical coefficients. We extend the discussion here to include other materials such as SBN[2] and $BaTiO_3$, which show good potential for periodic poling, but produced **optically** rather than via fixed electrode arrays.

Our optical periodic poling uses Cerium doped Strontium Barium Niobate ($Sr_xBa_{(1-x)}N$) (x=63 or 75) in which an optical grating is generated via two beam interference. The crystal properties are modified by the alternating light and dark intensity patterns, to permit spatially selective domain re-poling to occur, under the appropriate field/intensity parameters. We have investigated this scheme, with particular importance placed on the precise mechanism responsible for optical re-poling. Specifically we find that a number of the mechanisms suggested in the literature are not applicable. We are suggesting a model based on distortion of the local crystal field by photo-ionization of the cerium dopant. The intense local field causes a distortion in the ferroelectric potential of the nearby Niobium ions. Under random excitation of ions, configurations arise which reduce the coercive field of the material. This effect lasts only for the lifetime of the excited ion.

We also report on the practical design considerations effecting the optimum conditions for optical periodic poling. We have investigated the optimal wavelength, power, temperature and voltage for poling, and consider the best optical set-up for the system. We further discuss our results on using different non-destructive techniques for visualizing domains.

[1] A. Feisst and P. Koidl, Appl. Phys. Lett. **47** (11), pp.1125-1127 (1985).
[2] M. Horowitz, A. Bekker and B. Fischer, Appl. Phys. Lett. **62** (21), pp.2619-2621 (1993).