QUADRATIC NONLINEAR PROPERTIES OF POLED GLASSES

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Abstract

Recent progress on the poling of glasses in bulk and optical fibre form will be reviewed. Second order nonlinearities of order 1 pm/V have been realised in fibres, and efficient quasi-phase-matching structures should soon be available.

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Summary

Until fairly recently, second harmonic generation in specially treated glasses and glass fibres has been more of scientific that of practical interest, owing to the low attained levels of induced nonlinearity (several orders of magnitude less than in lithium niobate). During the past three years, however, a number of glass poling techniques have emerged that produce second order nonlinearities approaching 1 pm/V. Such high levels of nonlinearity are sufficient to be useful for parametric frequency conversion and electro-optic light modulation. These new poling techniques are: thermal poling of fused silica [1-3] at 250-300°C under an applied electric field (the second-order nonlinearity appears in a thin layer just under the

anode), thermal poling of tellurite glasses [4], corona poling of glass waveguides [5] and charge implantation by exposure to an electron-beam [2,6]. In this paper we review recent developments in the field, report on our own results on thermal and electron beam poling of glass, speculate on the underlying physical mechanisms, and assess the practical usefulness of the effect. Our recent results include the successful poling of germanosilicate optical fibre using both thermal and electron implantation techniques; effective quadratic nonlinearities as high as 0.2 pm/V were obtained in the fibre. Compared to previous work in germanosilicate fibres, this represents a 200-fold improvement in second-order nonlinearity. Recent progress on UV erasure of the thermally induced nonlinearity and on the formation of $\chi^{(2)}$ gratings will also be reported.

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