5.3 Information Storage in Ferroelectric Crystals

(G.W. Ross and M. Zgonik)

Inducing changes in material properties lies at the heart of information storage in crystals. Such changes may be either permanent (in the case of read-only memories) or reversible (for read/write memories). Inducing these changes optically adds the advantage of parallelism. Two main mechanisms are currently under consideration. The first mechanism (holographic) relies upon light-induced refractive index gratings caused by a redistribution of charge within the crystal. The second mechanism (domain reversal) relies upon light-assisted domain switching resulting from electric field induced changes in the atomic arrangement. The highly non-linear optical properties of ferroelectric materials, such as $KNbO_3$ and $LiNbO_3$, make them interesting candidates for investigation. Of particular interest is exposure of such materials to ultraviolet laser radiation. Interband charge excitation offers the possibility of fast (~µs) and robust grating formation thereby overcoming the long-recognised problem of slow crystal response at visible wavelengths. High holographic sensitivity using low UV powers has already been demonstrated in $KNbO_3$. In both $KNbO_3$ and doped samples of $LiNbO_3$, absorption at UV wavelengths is high and grating formation occurs close to the crystal surface. Using diffraction from such a grating in very thin samples of $KNbO_3$, we hope to construct a spatial light modulator that achieves high resolution frame-rate conversion of a white light image to an image-bearing coherent laser beam for optical processing. Of additional interest is the application of such thin gratings as distributed feedback structures in waveguide geometries. Besides the dynamic effects, we intend to examine also the problem of hologram fixing.