2.3 Photorefractive Effects in the Ultraviolet in $KNbO_3$ Single Crystals and Waveguides

(P. Bernasconi and G. Montemezzani)

The photorefractive effects at short wavelengths have been investigated in single domain crystals of pure $KNbO_3$ in order to get a deeper understanding of the mechanisms involving the direct band to band charge excitation. The isotropic as well as anisotropic Bragg diffraction experiments in both transversal and longitudinal configurations have revealed the complex dynamic which leads to the formation of the photorefractive phase gratings. By comparing the results obtained in extremely thin samples and in bulk crystals we have verified the simultaneous presence of at least two different holographic gratings related to different charge distributions, the first in the electronic bands and the other in the mid-gap energy levels, respectively. The relative strength of the two contributions may be modified by varying the crystal thickness or by adjusting the UV intensity. Unlike for $BaTiO_3$, an inhomogeneous illumination of $KNbO_3$ does not give rise to any substantial absorption grating. An important role is also played by the direction of the grating wave vector which does not only determine the effective electro-optic coefficient but it also changes the values of the mobility of the different charge carriers. The anisotropy in the charge mobility may explain why in some geometries the contributions from the two gratings tend to compensate each other and in some other configurations they add themselves constructively. The characteristic times describing the build up and decay of one kind of grating lie in the sub millisecond range and they are basically determined by the UV intensity (with 30 mW cm^{-2} we measured a build up time of 0.5 ms).

Similar experiments have been performed in ion implanted $KNbO_3$ waveguides where in the transversal geometry a transmission grating written with UV light deflected the guided beam. The efficiency of such a switch was as high as 2%, a value which was supposed to rise substantially by applying an external electric field. Unfortunately, the ion implantation procedure used to prepare the waveguides increases dramatically the conductivity of the samples and prevents the application of the required electric fields.