3.3 Two-Wave Mixing in $KNbO_3$:Fe Planar Waveguides at Near Infrared Wavelengths

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Photorefractive (PR) single domain crystals are widely investigated for all-optical signal processing, optical phase-conjugation and two-wave mixing. Iron-doped $KNbO_3$ is very interesting due to its large electro-optic coefficients and its high PR gain. In recent years attention has been drawn to the possibility of extending the crystal response up to communication wavelengths.

We have fabricated waveguides in iron-doped $KNbO_3$ by H^+ implantation. In these H^+ implanted waveguides the photorefractive sensitivity is extended towards near infrared wavelengths, where the virgin crystal is insensitive. These waveguides show two-beam coupling gain from the visible up to a wavelength of 1550 nm. The direction of the energy transfer is such that the majority charge carriers in the waveguide are electrons and not holes as in the bulk crystal. These results indicate that H^+ implantation not only creates a waveguiding thin layer by a modification of the refractive index, but also alters the PR properties of $KNbO_3$:Fe from p-type to n-type, increases the trap density and extends the sensitivity up to longer wavelengths. These effects lead to higher gain and faster response times than in the bulk crystal, thus providing a promising potential of ion-implanted Fe-doped $KNbO_3$ waveguides for applications at the telecommunication wavelengths of 830, 1300 and 1550 nm.