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This paper deals with the new properties of photoferroelectric materials and applications to information optical processing, with special attention to photoinduced change of refractive index and applications to optical storage.

Photoferroelectrics are materials both photo sensitive in the visible range and ferroelectric at room temperature. The bandgap of such materials being typically larger than 3 eV , photosensitivity is due to electron donor and trapping centers in the bandgap. Inhomogeneous illumination of such a material causes a space charge field repartition, that in turn modulates the refractive index via the electrooptic effect. A model is given that allows computing the amplitude, and the lifetime of the photoinduced electric field ΔE , versus numbers and cross sections of the donor and trapping centers. Examples of creation of such centers by ionic substitutions in the host lattice or by lattice defects generation using γ irradiation are given for LiNbO_3 , KNbO_3 , BaTiO_3 , and $\text{Ba}_2\text{NaNb}_2\text{O}_6$. Characterisations of these centers by photocurrents, thermocurrents and optical absorption measurements are discussed.

After having presented the main electrooptic and dielectric properties of ferroelectric materials, a general expression of the photoinduced change of the refractive index sensitivity is derived in terms of the photoconductivity parameters and of the electrooptic and dielectric characteristics. Comparisons between photosensitivity of known photoferroelectrics including the polycrystalline materials are presented.

Because of the low photoelectrons drift length ℓ , information optical storage must be achieved by using holographic techniques, since the fringe spacing can be choosed in accordance with the drift length ℓ . From the point vue of information storage, it is shown that the information recorded with such a process is not permanent, since thermal agitation and optical readout at the recording wavelength redistribute uniformly the displaced photoelectrons, and cause the erasure of the holographic pattern.

Two fixing processes have been discovered, that allow a permanent storage of the recorded information. The first is a thermal one, and involves displacements of thermally excited ions in the photoinduced charge fields. When returning at room temperature T_r , ions are frozen in the positions where they have been displaced at the fixing temperature $T_f > T_r$. This stable ionic pattern constitutes a copy of the original electronic pattern, and can be erased by raising the material at a temperature T_e higher than T_f .

The second fixing process is a fast electrical one, and uses the photoinduced changes of the coercive field E_c during recording. After the holographic recording, a field pulse with amplitude E nearly equal to E_c causes partial polarisation switching, that gives rise to a ferroelectric domain pattern. This photoinduced domain pattern constitutes a stable and high diffraction efficiency holographic pattern. Erasure can be achieved by applying a field pulse with amplitude larger than E_c that saturates the polarisation. Experimental results are given for these two fixing methods, in LiNbO_3 for the thermal one and in BaTiO_3 and $(\text{Ba}, \text{Sr})\text{Nb}_2\text{O}_6$ for the electrical one. Electrical methods for selecting recorded holograms are presented in layered $(\text{Ba}, \text{Sr})\text{Nb}_2\text{O}_6$ crystals and in bulk $(\text{Pb}, \text{La})(\text{Zr}, \text{Ti})\text{O}_3$ polycrystalline samples.

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Examples of uses such new materials are given in the field of optical memories ; organization and capability of these memories are briefly discussed.