8-7 A New Proposal for Electrooptic Image Storage Devices

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The recent development of transparent ferroelectric (FE) ceramics in the lanthanum modified lead zirconate (PLZT) solid solution system[1] has provided ferroelectric-photoconductive (FE-PC) image storage devices.[2,3] Two types of these devices have been constructed with controlled birefringence and controlled light scattering. Both types were developed based on optical properties which can be changed locally in a FE ceramic plate by changing the magnitude or direction of the average remanent polarization ⟨Pr⟩ in a given region of the plate.

The changes of light transmitted from an FE ceramic plate arise from the variation of interaction between an electric vector of an impinged light and a spatially distributed FE polarization vector. Therefore, these FE image storage devices have a fatal deficiency of contrast ratio to display the stored image in a wide angle.

The objective of this paper is to propose a new method in which an FE state is applied for a stored image; a non-FE state is also applied for an erased image. To provide the reader with an understanding of the principle of the present proposal, a brief description of a phase diagram of a certain composition in the PLZT solid solution system is shown in Fig. 1. This figure shows a morphotropic phase boundary between the FE and AFE phases which coexist in a composition of $Pb_{.93}La_{.07}(Zr_{.70}Ti_{.30})_{.98}O_3$ (abbreviated to 7/70/30-PLZT). Temperature variation of D-E hysteresis loops was observable at a temperature below T_c. Nonseparated double loops were evident in a temperature range of $\Delta T = T_h - T_m$ where FE and AFE states were both stable and a phase change occurred by applying an electric field.

Thus, in a ceramic plate of this composition, the field-induced phase transition occurred, resulting in the double hysteresis loops shown in Fig. 3. Figure 4 shows an I-E curve representing the relation between transmitted light intensity and an applied electric field, when the ceramic plate was placed between crossed polars and impressed by an electric field. In this I-E curve, the deep valleys correspond to the AFE-FE state in which no scattered light can be observed, and the hills correspond to the FE state in which strong scattered light can be observed.

Linearly polarized light transmitted through the AFE portion remained unchanged, while light scattered from the FE portion was depolarized as natural light and scattered in a very narrow angle. Therefore, when an image was stored in the plate, it could be clearly displayed with the aid of an analyzer.

Experiments on the FE-PC sandwich structures of 7/70/30-PLZT with 200μm-thick ceramic plates resulted in good capability of image storage device application to PLZT ceramics.

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2) A. H. Meitzler et al: Bell Syst. Tech. J., 49, 953 ('70) and Proc. IEEE 59, 368 ('71)

3) W. D. Smith and C. E. Land: Appl. Phys. Lett., 20, 169 ('72)

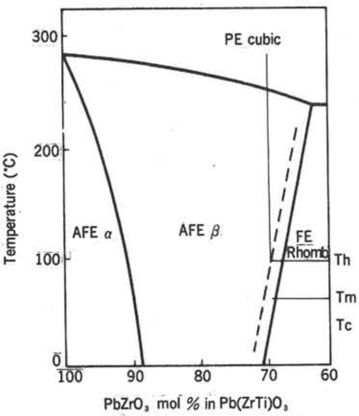

Fig.1 7/70/30 PLZT Phase diagram

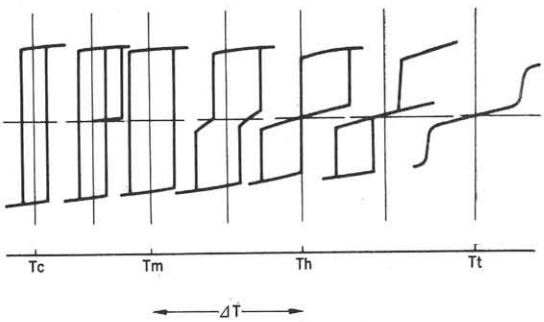

Fig.2 Temperature variation of D-E hysteresis loops of 7/70/30-PLZT

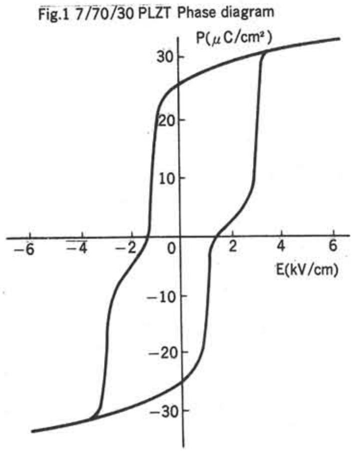

Fig.3 Double hysteresis loops of 7/70/30-PLZT at r.t.

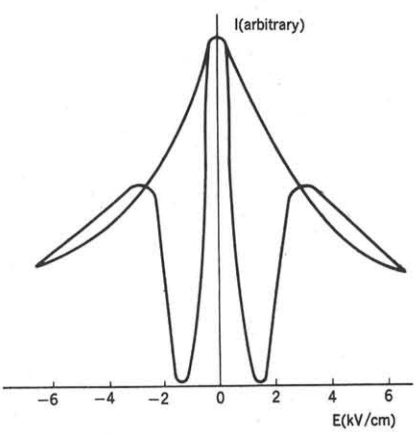

Fig.4 I-E characteristic curve of 7/70/30-PLZT at r.t.