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Effect of Impurity Doping on Photostriction in Ferroelectric Ceramics

Michio Tanimura and Kenji Uchino

Department of Physics, Sophia University,
Kioi-cho 7-1, Chiyoda-ku, Tokyo 102, Japan

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Photostriction in ferroelectrics is explainable by a superimposed effect of the photovoltaic effect with piezoelectricity. In this study, the photovoltaic effect in PLZT is investigated as a function of dopant, which is substituted at the A or B-sites as donors or acceptors. The photovoltaic response is affected by donor dopants situated at the B-site of the perovskite structure. Consequently, donor dopants at the B-site also enhance the photostriction, due to the fact that the dopant does not diminish the piezoelectric response. A photo-driven relay constructed utilizing donor-doped PLZT can be obtained that has a response time an order of magnitude faster than that previously reported.

1. Introduction

The photovoltaic effect is observed in certain ferroelectrics, from which a constant electromotive force is induced with the application of near-ultraviolet radiation.[1–3] Unlike the junction effect in semiconductors, this effect is observed even in uniform crystals, due to the noncentric symmetry of the crystal. This effect probably can be attributed to an excitation of electrons from an asymmetric potential of impurity (Glass et al. (1974)).[2] Previously, various single crystals such as $LiNbO_3$, $KNbO_3$ and $BaTiO_3$ have been investigated. Ceramic systems have been given far less attention, however, and to date only $BaTiO_3$ and PLZT ceramics have been investigated.

The main features of the bulk photovoltaic effect are summarized as follows:

1) The effect is observed in uniform crystals or ceramics having noncentric sym-