Indentation-induced local polarization reversal in La doped $BiFeO_3$ ceramics

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Stress-induced local polarization reversal was studied in La doped $BiFeO_3$ ceramics under the action of indentation. Piezoresponse force microscopy was used for study of domain structure before and after local polarization reversal. Two mechanisms of domain formation were revealed: (1) direct stress-induced and (2) stress mediated by grain clamping. Critical stress value for local polarization reversal was extracted from the dependence of the switched area on the applied loading force.

Ferroelectric materials are widely used for variety of electromechanical applications such as transducers and actuators [1,2], where they are protractedly exposed by electrical and mechanical loads. While polarization reversal under the action of electric field has been comprehensively studied for decades, influence of mechanical stress on it is still not totally understood. Mechanical stress was shown to induce phase transitions [3], modification of electromechanical properties [4], and polarization reversal [5] in ferroelectric materials. By analogy with electric field induced local polarization reversal, where non-uniform electric field is created by the biased tip of scanning probe microscope (SPM), indentation of a ferroelectric with enough load can induce polarization reversal

In present paper we investigated solid phase synthesized $BiFeO_3$ ceramics doped by 5% La. Local polarization reversal under the action of mechanical load performed by Berkovich type prism indentation was studied. Nanoscale domain structure and polar-to-nonpolar phase transition was observed in the area of plastic deformation. Appearance of the stress-induced ferroelastic domains in the vicinity of the plastic deformation area is caused by mechanical energy minimization. Indirect action of grain clamping by neighboring grain resulted in shrinkage of existed ferroelastic domains and nucleation of new domains in the vicinity of the grain boundaries. It was found that the switched area is linearly dependent on the applied load force. The evaluated ин fitting critical stress σ_c =14.6 MPa for local polarization reversal induced by indentation is close to the values measured in the other ferroelectric materials. The obtained results are significant for understanding the effect of the mechanical stress mediated depolarization in ferroelectric ceramics.

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ВЛИЯНИЕ СЛОИСТОГО СТРУКТУРИРОВАНИЯ НА ОБМЕННОЕ СМЕЩЕНИЕ В ПЛЕНКАХ $FeMn/X/Fe_{20}Ni_{80}$ (X = Ta, Gd)

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EFFECT OF LAYERED STRUCTURING ON EXCHANGE BIAS IN $FeMn/X/Fe_{20}Ni_{80}$ (X = Ta, Gd) FILMS

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Annotation. The influence of Ta and Gd spacers on the exchange bias in $Fe_{50}Mn_{50}$/ $Fe_{20}Ni_{80}$ multilayers at the temperature range of 5-350 K was investigated.

Магнитные пленки на основе обменно-связанных слоев ферромагнетика и антиферромагнетика являются объектом многих исследований, ориентированных, в том числе, на разработку сред для магнитных сенсоров [1]. Данная работа посвящена изучению влияния тонких прослоек между антиферромагнитным слоем $Fe_{50}Mn_{50}$ и ферромагнитным слоем $Fe_{20}Ni_{80}$ на обменное смещение последнего. В качестве таких прослоек были выбраны Gd, обладающий ферромагнитным упорядочением в диапазоне температур ниже комнатной, и Ta, являющийся парамагнетиком во всей рассматриваемой температурной области.