SPONTANEOUS BACKSWITCHING DURING TIP-INDUCED POLARIZATION REVERSAL AT LITHIUM NIOBATE NON-POLAR SURFACES

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The fabrication of short period domain structures in single crystals of lithium niobate (LN) for the novel generation of non-linear optical devices stimulates the investigation of the domain structure evolution [1]. Local polarization reversal at the non-polar surfaces of LN by conductive tip of scanning probe microscope gives a unique possibility to study with high spatial resolution the forward domain growth being one of the main stages of domain evolution weakly studied due to significant experimental difficulties [2].

The forward growth and spontaneous backswitching were studied systematically during local polarization reversal at the X and Y non-polar surfaces of LN single crystals doped with 5% magnesium oxide (MgO:LN). The domain structure was visualized by piezoelectric force microscopy (PFM). The voltage pulses with different amplitudes, durations and decay times in frame of two different switching modes: (1) with tip remaining in contact under the end of switching pulse and (2) tip withdrawing just after voltage switch-off were applied.

It was revealed that remaining of the tip in contact in contrast to tip withdrawing resulted in spontaneous backswitching which represents: decreasing of the domain size, up to complete disappearance, and appearance of the domain with the polarization direction opposite to the applied external field. The withdraw mode reduced the backswitching effect significantly (Fig. 1).

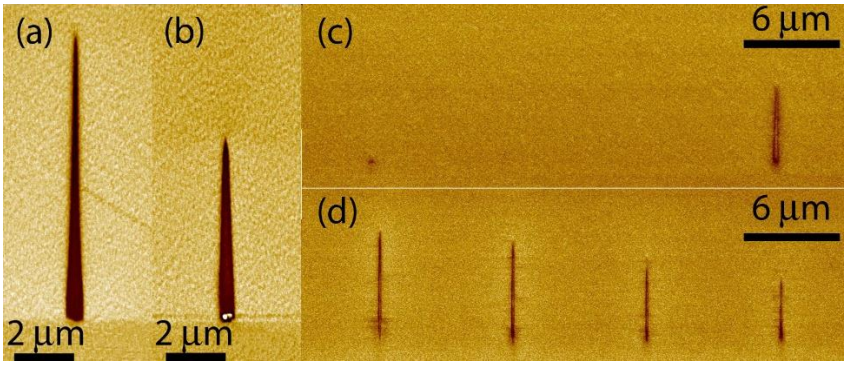

Fig.1. PFM domain images at Y-cut MgO:LN switched by single pulses (90 V, 500 ms): (a) the tip withdrawn from the surface, (b) the tip remained in contact. Series of domains produced by switching with tip remained in contact with pulse decay time: (c) 10 ms, (d) 100 ms.

The results were attributed to key role of external screening of depolarization field by current in the external circuit for tip in contact [3]. Withdraw of the tip just after polarization reversal leads to absence of external screening which hampered the domain backswitching. For tip remained in contact the effective external screening promoted the backswitching.

The equipment of the Ural Center for Shared Use “Modern nanotechnology” UrFU was used.

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ОСОБЕННОСТИ ВОЗБУЖДЕНИЯ И ПРИМЕНЕНИЕ МАГНИТОАКУСТИЧЕСКОЙ ЭМИССИИ В СТРУКТУРОСКОПИИ МАТЕРИАЛОВ

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FEATURES OF EXCITATION AND APPLICATION OF MAGNETOACOUSTIC EMISSION IN STRUCTURESCOPY OF MATERIALS

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Dependence of magnetoacoustic emission (MAE) amplitude on remagnetizing field for a group of metallic ferromagnets of different sizes and with different physical features was researched. It is shown that along with residual magnetic induction of steels amplitude of MAE is a universal testing parameter of softening thermal treatment and it could be used in scanning structurescopy systems.

Магнитоакустической эмиссией (МАЭ) принято называть всю совокупность упругих колебаний, возникающих в ферромагнетике при его перемагничивании. При низкочастотном перемагничивании существует два основных механизма МАЭ: магнитострикционный, проявление которого заключается в изменении размеров образца, и возникновение локальных упругих возмущений, преимуще-