

SYNTHESIS AND INVESTIGATIONS OF $\text{Pb}(\text{Zr}_x\text{Ti}_{1-x})\text{O}_3$ STRUCTURES IN SWIFT HEAVY ION TRACKS

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Structures containing ferroelectric nanoclusters $\text{Pb}(\text{Zr}_{0.54}\text{Ti}_{0.46})\text{O}_3$ (PZT), uniformly distributed in nanopores obtained by etching of swift heavy ion (SHI) tracks formed in silicon dioxide thin layers [1] are obtained and investigated in the present work. The SHI tracks are obtained by irradiation of $\text{SiO}_2/\text{n-Si}$ samples by $^{197}\text{Au}^{26+}$ ions with energy 350 MeV and fluence $5 \times 10^8 \text{ cm}^{-2}$. PZT clusters are synthesized by means of chemical deposition of Pb, Zr and Ti by method described in the paper [2] in nanopores having form of frustums with an average cross-section of 100 nm with subsequent annealing at temperature 550°C and partial pressure $p_{\text{O}_2} = 2 \times 10^5 \text{ Pa}$ (Fig.1). A control of evolution of $\text{Pb}(\text{Zr}_{0.54}\text{Ti}_{0.46})\text{O}_3$ clusters structure creation in nanopores after their additional annealing at $T_{\text{anneal}} = 550^\circ\text{C}$ and $p_{\text{O}_2} = 2 \times 10^5 \text{ Pa}$ during various time periods was carried out X-ray photoemission spectroscopy (XPS). Due to optimization of the Ti–O–Ti bonds formation in the obtained structure during annealing the largest maximum was observed on the XPS spectra. It corresponded to nanoclusters with a tetragonal phase at annealing during 8 min. It is supposed that a mutual diffusion of components takes place during the annealing process. With that the oxygen implementation in Zr–Ti double nanoclusters takes place both from the gaseous phase and by means of surface diffusion of oxygen along the ion track walls. The fact that $\text{Pb}(\text{Zr}_{0.54}\text{Ti}_{0.46})\text{O}_3$ nanoclusters have the a tetragonal phase can make it possible that the obtained structures can be used as ferroelectric sensors [3].

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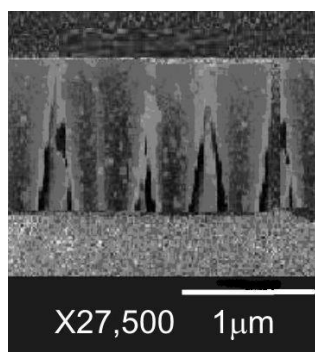


Fig.1: a scanning electron microscopy image of the cross-section of $\text{SiO}_2/\text{n-Si}$ samples containing nanopores and $\text{Pb}(\text{Zr}_{0.54}\text{Ti}_{0.46})\text{O}_3$ clusters.

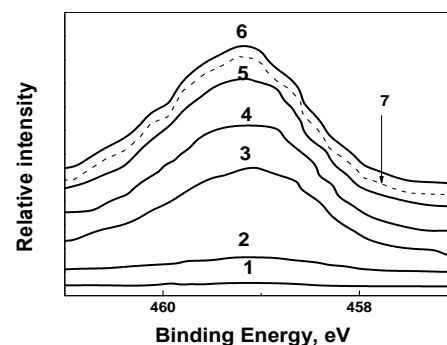


Fig.2: X-ray photoemission spectroscopy spectra of the sample with $\text{Pb}(\text{Zr}_{0.54}\text{Ti}_{0.46})\text{O}_3$ clusters in nanopores of SiO_2 thin layers for various annealing time at temperature 550° C.

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