The non-volatile ferroelectric memory (FRAM) on the base of $SrBi_2Ta_2O_9$ sol-gel films

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Summary

The possibility of the development of the non-volatile ferroelectric memory (FRAM) on the base of $SrBi_2Ta_2O_9$ (SBT) films synthesized by sol-gel method is discussed. The technology of samples preparation by sol-gel method is described. The AFM images, X-ray and IR spectra of $SrBi_2Ta_2O_9$ (SBT) films synthesized by sol-gel method are investigated.

Introduction

The development of memories on the basis of non-volatile ferroelectric (FRAM) and magnetoelectric (MRAM) memories are very perspective now. These devices should possess the certain set of properties which are necessary for their practical application. In particular, ideal ferroelectric should have the small dielectric constant, comprehensible value of spontaneous polarization (Pr ~ 5 μC/cm2) and Curie temperature exceeding a temperature range of using of the developed device. It also should possess a low working voltage (<5 V), that requires the formation of the working elements as submicron films, and also low coercivity and sufficient value of dielectric breakdown. The synthesized films should be homogeneous on structure and thickness, to have good fatigue characteristics (i.e. to not change value of remanent polarization after repeated carrying out of cycles inclusion/deenergizing) and to possess small leakage current. The ferroelectric $SrBi_2Ta_2O_9$ (SBT) satisfies to the majority of these requirements. It can be produced, in particular, by sol-gel method. It is one of perspective methods of crystal nanostructures synthesis, based on joint sedimentation hydroxides of metals with the subsequent crystallization of these oxides at heat treatment. This method is simple enough and allows to vary the properties of synthesized materials over a wide range, to reach significant interaction of components and demanded dispersiveness. Ferroelectric coverings can be successfully used in the devices of non-volatile memory.

Experimental

In Advanced Materials Research Laboratory of the F. Skorina Gomel State University for a number of years is successfully used sol-gel method of synthesis of three-dimensional and two-dimensional matrixes with varied properties. In particular, during the previous researches have been synthesized sol-gel matrix with various structure for application in optoelectronics, laser techniques, fiber optics; as protective and isolating coverings. Sol-gel technology is much more economic and ecologically pure, than, for example, vacuum and plasma methods of thin films synthesis. Besides sol-gel matrix have mechanical durability, chemical inertness, possess an opportunity to change of character and interaction force of nanoparticles and the matrix.

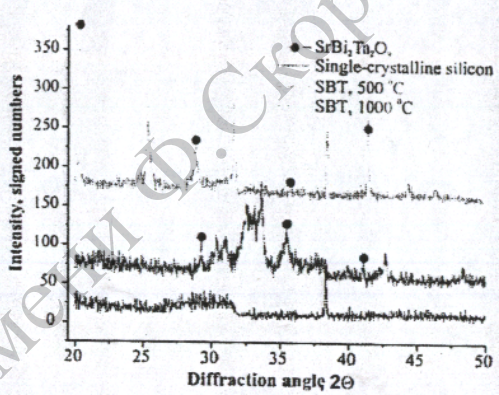

Fig. 1. X-ray spectra of $SrBi_2Ta_2O_9$ powders and films

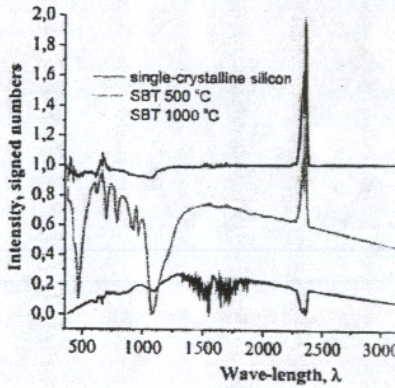

Fig. 2. Infrared spectra of $SrBi_2Ta_2O_9$ sol-gel films

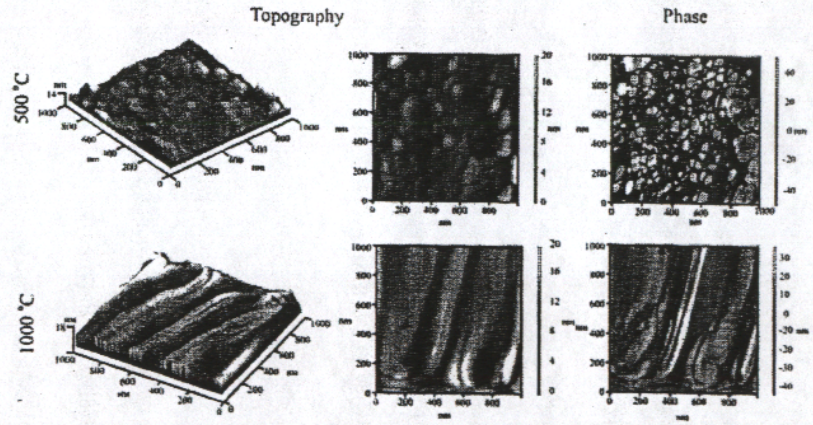

Fig. 3. AFM images of $SrBi_2Ta_2O_9$ (SBT) films synthesized by sol-gel method

Conclusion

Sol-gel method is one of the perspective methods of crystal nanostructures synthesis, based on joint sedimentation of metals hydroxides with the subsequent crystallization of these oxides at heat treatment. It is possible to synthesize the ferroelectric SBT-structures by sol-gel.