

Abstract

Project Code: TRG5680095

Project Title: Influent of Tantalum dopant on electrical fatigue behavior of lead-free ferroelectric ceramic $(K_{0.50}Na_{0.46}Li_{0.04})(Nb_{(0.96-x)}Sb_{0.04}Ta_x)O_3$

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Project Period: 2 years

Keywords: KNN-LST, Lead-free ferroelectric, Electrical fatigue, Domain orientation

The purpose of this research is to study the effect of tantalum (Ta^{5+}) dopant on the electrical properties, domain switching behavior and electrical fatigue behavior of potassium sodium niobate doped with lithium, antimony and tantalum $(K_{0.50}Na_{0.46}Li_{0.04})(Nb_{(0.96-x)}Sb_{0.04}Ta_x)O_3$: KNN-LST, where $x = 0.00$ to 0.12 mol. KNN-LST samples were synthesized by solid-state reaction method. After synthesizing, the phase analysis was conducted by using x-ray diffraction. The samples then were poled at 2.5 kV/mm and subjected to electrical fatigue test at ± 2.5 kV/mm and 50 Hz. The fatigue test was conducted up to 10^6 cycles. The change of domain orientation was analyzed by using x-rays diffraction (XRD) before and after fatigue testing. Furthermore, the change of microstructure was investigated by scanning electron

microscope (SEM). During the test, ferroelectric and dielectric properties of the samples were measured to detect the degradation of sample properties.

The results showed that the phase was changed from orthorhombic to tetragonal and the piezoelectric constant increased with the amount of Ta^{5+} dopant. The fatigue degradation could be caused by two reasons: 1) the domain wall pinning effect and 2) the damage on the electrode surfaces and the region near electrode interfaces. It was also found that all compositions of KNN-LST were degraded after being subjected to 10^5 loading cycles while KNN-LST at $x = 0.08$ is less degraded.