ENVIRONMENTAL FRIENDLY LEAD FREE PIEZOELECTRIC CERAMICS

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Abstract

The interconnectivity between mechanical and electrical energy specific for the ferroelectric ceramics, enables their application in a wide range of devices. Lead oxide based ferroelectrics are the most widely used materials for actuators, sensors and microelectronic applications, due to their excellent piezoelectric properties. Because of the toxicity of lead oxide, researchers are now focusing on to substituting this compound [1]. Lead-free piezoelectric materials are nowadays receiving increasing attention, since recent reports showed that they are promising candidates for lead-free piezoelectric materials [2]. Of considerable interest is the (K,Na)NbO3 (KNN)-based system, which possesses a relatively high Curie temperature and good piezoelectric properties. Also, the temperature independence of the morphologic phase boundary (MPB) for such materials enables a good temperature stability of the piezoelectric and ferroelectric properties [3, 4].

In this study, lead-free KNN piezoelectric ceramics doped with x mol % $SmBO_3$ (x= 0,25; 0,5; 0,75; 1; 2,5; 5 and B= Al, Co, Cr, Fe, Mn), were prepared by conventional ceramic processing. The crystalline structures of the obtained ceramics were analyzed by X-ray diffraction using a PanAnalytical X'Pert Pro MPD diffractometer. The microstructure was analyzed using SEM techniques. The dielectric measurements (room temperature, from 100Hz up to 5MHz) were performed with a 42 Hz–5 MHz Programmable Impedance/LRC meter TEGAM model 3550. The planar piezoelectric properties were measured using the resonance method with an impedance analyzer Agilent E5100A. The increase of the piezoelectric properties and decrease in grain size proves that such piezoelectric ceramics can be used for sensing applications.

References

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