

Abstract

Lead-Free KNbO₃ Piezoceramics synthesized by Pressure-less Sintering

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Dense KNbO₃ ceramics have been successfully synthesized by pressure-less sintering under optimized heat-treatment conditions using a small amount of La₂O₃ and Fe₂O₃ additives. X-ray diffraction (XRD) analysis revealed that KNbO₃ forms (K_{1-x}La_x)(Nb_{1-x}Fe_x)O₃ solid solutions and changes in the crystal system, depending on the additive content, from orthorhombic to tetragonal at x of 0.020, and from tetragonal to cubic at x of 0.200 or higher. When only 0.002 mol of La₂O₃ and Fe₂O₃ ($x=0.002$) was added into KNbO₃, the highest value (98%) of the theoretical density was obtained. This specimen showed orthorhombic symmetry with a high Curie temperature of 420°C, and demonstrated a well-saturated ferroelectric hysteresis loop with large remanent polarization (P_r) of 18 $\mu\text{C}/\text{cm}^2$, which is comparable to the value reported for pure KNbO₃ ceramics fabricated by hot pressing. Furthermore, the $x=0.002$ specimen showed a planar electromechanical coupling ratio (k_p) of 0.17 and thickness mode (k_t) of 0.47. The piezoelectric d_{33} constant was 98 pC/N.