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「課程博士用」

学 位 論 文 の 要 旨

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学位論文題目	Study of crystallinity and piezoelectric properties of KNNS-BZ-BKH ceramics for Energy Harvesting 環境発電に向けた KNNS-BZ-BKH セラミックの 結晶性と圧電特性の研究		

学位論文要旨

In order to study how to improve the crystallinity and precise composition of (K, Na) (Nb, Sb) O_3-based piezoelectric materials in lead-free piezoelectric material, this article explains the following main objective:

- Element control of (K, Na) (Nb, Sb) O_3-based lead-free piezoelectric materials
- Optimization of sintering temperatures for (K, Na) (Nb, Sb) O_3-based lead-free piezoelectric materials
- Production of (K, Na) (Nb, Sb) O_3-based lead-free piezoelectric material pellets

This thesis contains five chapters as follows:

Chapter 1 describes the attractive function of piezoelectric materials as general background. Pb (Zr, Ti)O_3 (PZT) materials are among the most important for piezoelectric applications, such as actuators, sensors, and energy harvesting. However, in recent years, the pressure of environmental protection and the EU RoHS (The Restriction of Hazardous Substances Directive) regulations have all put forward requirements for lead-free piezoelectric materials. (K, Na) (Nb, Sb) O_3-based piezoelectric materials have become one of the most promising lead-free piezoelectric materials due to their huge d_{33} and excellent electrical properties. The current research on (K, Na) (Nb, Sb) O_3-based piezoelectric materials mainly focuses on the influence of various additives on the phase transition temperature and electrical properties.

Chapter 2 describes the purpose and aim of this study to investigate (K, Na) (Nb, Sb) O_3-based lead-free piezoelectric materials.

Chapter 3 introduces the research direction of (K, Na) NbO_3-based lead-free piezoelectric materials, describes the production process, and analysis of the (K, Na) (Nb, Sb) O_3-based piezoelectric materials, including the process from starting powders to polarized pellets to estimate the piezoelectric properties. The two o main experimental procedures of this study were discussed as follows: First, the powder experiment includes the analysis and control of the composition of the material; Second, the pellet experiment includes the control of sintering and polarization process, X-ray powder diffraction, and Scanning electron microscope /Energy-dispersive X-ray spectroscopy were used for analysis in both experimental processes.

Chapter 4 discusses the experimental results, compares the X-ray powder diffraction results of powder samples under different heating program patterns, X-ray powder diffraction results of powder samples under different mol% K, and compares the X-ray powder diffraction results and electrical properties pellet samples under different mol% K.

Finally, the conclusion summarizes the experimental results and discusses the research direction of optimizing the crystal structure and electrical properties of (K, Na) (Nb, Sb) O_3-based piezoelectric ceramics.

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