Characterization of (Na,K)NbO$_3$-Based Pb-free Piezoelectrics Doped with Cu-oxides

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Abstract: Recent efforts in developing Pb-free piezoelectrics have focused on the characterization of (Na,K)NbO$_3$-based materials. In this study, we investigated the effects of Cu-oxide doping on the piezoelectric properties of (Na,K)NbO$_3$. Key characterization techniques included X-ray diffraction (XRD), scanning electron microscopy (SEM), and piezoelectric measurements.

Keywords: (Na,K)NbO$_3$ ceramics, Piezoelectric properties, Cu oxides, doping effects

1. Introduction

PZT (lead titanate) is a widely used piezoelectric material due to its high piezoelectric properties. However, the use of Pb in its composition has raised concerns about environmental and health issues. Therefore, there has been a growing interest in developing Pb-free piezoelectrics. (Na,K)NbO$_3$ is a well-known piezoelectric material that can be modified to reduce its Pb content. In this study, we explored the effect of Cu-oxide doping on the piezoelectric properties of (Na,K)NbO$_3$.

2. Materials and Methods

The (Na,K)NbO$_3$ powder was synthesized using a solid-state reaction method. Cu-oxide powder was mixed with the (Na,K)NbO$_3$ powder in various weight percentages. The mixed powders were then sintered at high temperatures to form the ceramic samples. The piezoelectric properties were measured using a piezoelectric testing machine.

3. Results and Discussion

The piezoelectric properties of the (Na,K)NbO$_3$-CuO samples were found to be significantly improved compared to undoped (Na,K)NbO$_3$. The electromechanical coupling factor, d$_{33}$, and piezoelectric constant, k$_{33}$, were found to increase with increasing Cu-oxide concentration.

4. Conclusion

The results of this study suggest that Cu-oxide doping can be an effective method for improving the piezoelectric properties of (Na,K)NbO$_3$. Further research is needed to optimize the doping level and understand the underlying mechanisms.

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References


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