

Research Title: Lead free ferroelectric ceramic based on a layered perovskite Dion-Jacobson phase for high temperature application

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ABSTRACT

This aim of this research is to investigate the synthesis parameter for preparing the layer-type perovskite structure with Dion-Jacobson materials. The $\text{BaCaNb}_2\text{O}_7$, $\text{BaCaTa}_2\text{O}_7$, KBiNb_2O_7 , KBiTa_2O_7 , $\text{KCa}_2\text{Nb}_3\text{O}_{10}$, $\text{KCa}_2\text{Ta}_3\text{O}_{10}$, $\text{RbBi}(\text{Nb}_{2-x}\text{Ti}_x)\text{O}_7$, $\text{Rb}(\text{Bi}_{1-x}\text{Nd}_x)\text{Nb}_2\text{O}_7$, $\text{Rb}(\text{Bi}_{1-x}\text{Pb}_x)\text{Nb}_2\text{O}_7$, and $\text{Rb}(\text{Bi}_{1-x}\text{Ce}_x)\text{Nb}_2\text{O}_7$ were selected in this work. All powders were synthesized by conventional solid-state reaction method involving the use of high-purity starting materials. Phase evolution, crystal structure, thermal analysis, and morphology were studied. For the $\text{BaCaNb}_2\text{O}_7$, $\text{BaCaTa}_2\text{O}_7$, KBiNb_2O_7 , KBiTa_2O_7 , $\text{RbBi}(\text{Nb}_{2-x}\text{Ti}_x)\text{O}_7$, $\text{Rb}(\text{Bi}_{1-x}\text{Nd}_x)\text{Nb}_2\text{O}_7$, $\text{Rb}(\text{Bi}_{1-x}\text{Pb}_x)\text{Nb}_2\text{O}_7$, and $\text{Rb}(\text{Bi}_{1-x}\text{Ce}_x)\text{Nb}_2\text{O}_7$ powders, the main pattern peaks of XRD data matched well with the peaks on JCPDS data standard. However, pure Dion-Jacobson structure was not successfully synthesized in the temperature range of 1150-1300 °C for 4h. FT-IR spectra also supported XRD data. However, the $\text{KCa}_2\text{Nb}_3\text{O}_{10}$ and $\text{KCa}_2\text{Ta}_3\text{O}_{10}$ were successfully synthesized in the pure Dion-Jacobson phase with orthorhombic structure. Also, Scanning electron micrograph showed plate-like grain and average particle size of $3.34 \pm 0.86 \mu\text{m}$ and $3.86 \pm 0.56 \mu\text{m}$ for the $\text{KCa}_2\text{Nb}_3\text{O}_{10}$ and $\text{KCa}_2\text{Ta}_3\text{O}_{10}$ powder, respectively. The stability of Dion-Jacobson structure is strongly related to the ionic radius of the A-site more than B-site. The exfoliation process of Dion-Jacobson to 2D nanosheet will be studied in near future.

Keywords: Dion-Jacobson phase, Ferroelectric materials, Solid state reaction.