Importance of mixing and milling on sintered densities and reproducibility for K0.5Na0.5NbO3 piezoelectric ceramics.

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Abstract

Piezoelectric ceramics are used in many modern day appliances. High performance piezoelectric ceramics are often made with lead compounds. Because the health risk associated with lead, great interest has been shown in further development of non-lead containing ceramics. One promising lead-free piezoelectric family of ceramics are those based on K0.5Na0.5NbO3. Sintering of this ceramic has often proven to be difficult and the addition of strontium as a sintering agent can be beneficial.

An initial attempt to produce such ceramics using traditional repeated ball milling and calcination steps lead to poor reproducibility and relatively low densities (¡ 90%). Characterization of the raw materials (particle size distribution, SEM) showed that the different starting powders had very different sizes and morphologies. Modification of the raw material size distributions by wet attrition milling decreased the sodium and potassium carbonates by nearly two orders of magnitude and the niobium oxide and strontium carbonate by one order of magnitude.

Using these starting powders with median volume diameters between 2 and 4 microns, followed by ball milling, attrition milling, calcination and dry pressing, sintered densities around 95% could be achieved. Microstructural and piezoelectric property characterization is currently underway and preliminary results will be described and discussed.