Article

Synthesis and Characterization of Nanocrystalline $PbTiO_3$

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Abstract

Nanocrystalline $PbTiO_3$ in tetragonal form has been successfully prepared via a newly developed environmentally friendly coprecipitation process. The formation process of lead titanate from the $PbC_2O_4 \cdot TiO_2$ precursor was monitored using DTA–TG, XRD, FT-IR, and TEM techniques. XRD showed the phase transition of less stable tetragonal PbO decomposition intermediate to a more stable orthorhombic structure by raising the calcination temperature. For the precursor calcined at 600 °C, only XRD lines characteristic of nanocrystalline tetragonal $PbTiO_3$ are detected. TEM of $PbTiO_3$ nanocrystals showed agglomerates with diameters in the range 85–90 nm. Consistent with the TEM result, the grain size estimated using surface area measurements indicated a high degree of particle agglomeration. FT-IR measurements gave results which are in close agreement with those revealed by XRD technique. The ac conductivity of $PbTiO_3$ depends on the dielectric property. The kinetics of the nonisothermal TG curves for the precursor decomposition was carried out assuming various solid-state-reaction models and applying three different computational methods. The data analysis showed that the presence of TiO_2 during oxalate decomposition reaction does not alter the decomposition mechanism; it drastically affects the activation parameter values.

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