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The properties of nano BaTiO3 ceramics fabricated by high pressure

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Abstract

Barium titanate ($BaTiO_3$: BT) is one of the most extensively studied ferroelectric materials. It is well know that the successive phase transitions of $BaTiO_3$ bulk crystal occur at three temperatures in the near 403K (T_c), 298K (T_{t-o}) and 183K (T_{o-r}). Above the Curie temperature, the structure of $BaTiO_3$ is cubic and paraelectric. Below Tc, the structure is slightly distorted and three ferroelectric polymorphs appear continuously depending on temperature. It is generally observed that the phase transition temperature of $BaTiO_3$ crystal strongly depends on its grain size, and the T_c shifts to lower temperature, the T_{t-o} and T_{o-r} to higher temperature with reducing grain size. Since it is difficult to process the nanocrystalline powders into high quality dense bulk products that retain the original nanocrystalline grain size, the crystal structure of nanocrystalline $BaTiO_3$ ceramics is still a controversial topic.

By applying pressure during sintering, high density ceramics can be fabricated due to the pressure induced increase of the densification driving force. On the other hand, the growth rate is dramatically reduced under high pressure because of the decrease of diffusivity with pressure. So high pressure sintering can be an optimal approach to obtain nanocrystalline ceramics.

In this presentation, we report that high quality nano $BaTiO_3$ bulk of high density and homogeneous grain size could be prepared from the 10nm $BaTiO_3$ raw powder by using a specified high pressure sintering route, i.e. the three-step method. The obtained 28nm $BaTiO_3$ bulk retains original nanocrystalline grain size. X-ray diffraction pattern and Raman spectrum at various temperatures indicated that successive phase transitions certainly occurred in nano BaTiO3 ceramics.

Key words: $BaTiO_3$; High pressure; Nanocrystalline ceramics

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