Synthesis, Characterization, and Dielectric Properties of Y_2NiMnO_6 Ceramics Prepared by A Simple Thermal Decomposition Route

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In attempt to search for an improved material preparation technique, Y_2NiMnO_6 dielectric material is prepared by a one-step thermal decomposition route where a solution of stoichiometric mixtures of metal acetates is directly heated. Structural characterization by X-ray diffraction and electron diffraction shows that the samples are successfully prepared at relatively low temperature comparing to a standard solid state synthesis. Results from several techniques including thermal analysis, electron microscopy, and X-ray absorption are used to investigate compound formation. It is revealed that metal acetates decompose at 300-350^{o}C resulting in mixture of several metal oxide intermediates which continue to react to form the desired product. Y_2NiMnO_6 nanoparticles are first obtained at 800^{o}C. Later, these nanoparticles agglomerate and grow at higher temperature and/or longer heating time to give larger particle size and more crystallinity. Although the starting reagent contains Mn in 2+ oxidation state, X-ray absorption (XANES) analysis indicates that the obtained Y_2NiMnO_6 contain Mn and Ni in 4+ and 2+ oxidation states, respectively. Ceramic sample shows large dielectric constant of about 6000-7000 at 30-120^{o}C at 1kHz. Dielectric constant and dielectric response of the sample are consistent with those reported in other works where different synthetic techniques were used [1]. The activation energy of dielectric relaxation is similar to the energy required to transfer electrons between Ni^{2+} to Mn^{4+}, thus the observed large dielectric constant is intrinsically related to electronic ferroelectricity due to charge ordering of Ni^{2+} and Mn^{4+}.

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[1] M. H. Tang, Y. G. Xiao, B. Jiang, J. W. Hou, J. C. Li, and J. He, Appl. Phys. A. **105**, 679 (2011).