BST Ferroelectric Material Produced by Hydrothermal Method

K. A. Razak, W. Gao and J. Yoo
Department of Chemical and Materials Engineering,
The University of Auckland, Private Bag 92019, Auckland, New Zealand
E-mail: kabd006@ec.auckland.ac.nz

ABSTRACT

Barium strontium titanate, $Ba_xSr_{1-x}TiO_3$ (BST), is a ferroelectric material with high dielectric constant and low dielectric loss, which finds applications such as capacitors and phase shifters. This paper describes the processing of BST ferroelectric materials by using hydrothermal technique. Hydrothermal technique involves reaction (precipitation or dissolution) of inorganic solids in an aqueous solution at certain elevated temperatures. This technique is capable of producing ceramic powders with sub-micron to nano size. Thus, calcination process which may cause particles agglomeration and grain growth is not essential in this technique to obtain crystalline phases. In this work, $BaCl_2 \cdot 2H_2O$ and $SrCl_2 \cdot 6H_2O$ was reacted in distilled water containing NaOH at 80ºC for two hours. Nano-sized TiO_2 powder was then mixed into the reacted solution before subjecting to the hydrothermal reaction. Hydrothermal reaction was carried out in a PTFE lined pressure vessel at 180ºC. It was found that the stoichiometry of BST powder can be controlled by controlling the amount of TiO_2 powder in hydrothermal reaction, the ratio of Ba to Sr and the total concentration of Ba and Sr in the initial solution. Ba content, x, in BST powder increases exponentially with increasing Ba mole ratio in the initial solution. Selected powders were used to make film by electrophoretic deposition (EPD). After that the films were sintered at 1300ºC for 3 and 6 hours to improve the microstructure for densification. It was found that the dielectric constant at room temperature decreases with increasing Sr content, however, the dielectric loss decreases with increasing Sr content.

Keywords: barium strontium titanate (BST), ferroelectrics, dielectric properties, hydrothermal, stoichiometry

Materials Processing for Properties and Performance (MP3) Vol. 3
Edited by K.A. Khor, R. V. Ramanujan, C. P. Ooi and J. H. Zhao
Institute of Materials East Asia, 2004