ICAM2009
11th International Conference on Advanced Materials
Rio de Janeiro Brazil
September 20 - 25

Microwave Synthesis of single-crystalline perovskite $BiFeO_3$

G. Biasotto[(1)*], A. Z. Simões[(2)], M. A.Zaghete[(1)], E. Longo[(1)] and J.A. Varela[(1)]

(1) Laboratório Interdisciplinar em Cerâmica, Departamento de Físico-Química, Instituto de Química, Universidade Estadual Paulista, R. Francisco Degni, s/n, Bairro Quitandinha, Araraquara - SP, Brazil.
(2) Universidade Federal de Itajubá- Unifei- Campus Itabira, Rua São Paulo, 377, Bairro Amazonas, Itabira - MG, Brazil.
* e-mail: glendabiasotto@uol.com.br

Abstract - A low-temperature hydrothermal synthesis route was utilized to fabricate single-phase $BiFeO_3$ (BFO) crystallites. Effects of the reaction temperature and duration time on the phase evolution, the particle size and morphologies of BFO crystallites were investigated. X-ray diffraction results indicated that perovskite BFO crystallites have been synthesized at the temperature of 180°C for 1 hour using the KOH concentration of 4M. The ferroelectric Curie temperature of our hydrothermal BFO crystallites was determined by differential thermal analysis. The hydrothermal reactions to form crystalline BFO powders were discussed based on the dissolution–crystallization process.

Bismuth ferrite, one of the very few multiferroics with a simultaneous coexistence of ferroelectric and antiferromagnetic order parameters in perovskite structure, has attracted much attention for many decades since 1960. $BiFeO_3$ (BFO) has a ferroelectric Curie temperature T_c of 850°C and an antiferromagnetic Neel temperature of 370°C [1-2]. However, potential applications of BFO in the memory devices, sensors, satellite communications, optical filters and smart devices were greatly limited due to its low insulation resistance caused by the reduction of Fe^{3+} species to Fe^{2+} and oxygen vacancies for charge compensation.

A low-temperature hydrothermal synthesis route was utilized to fabricate single-phase $BiFeO_3$ (BFO) crystallites. BFO was synthesized from an equimolar mixture of $Bi(NO_3)_3\ 5H_2O$ and $Fe(NO_3)_3 9H_2O$ in 40ml using KOH as mineralizer. The mixture was then transferred to a 125 ml Teflon reactor and placed in a microwave oven Mars-5, CEM. The microwave reaction was carried out at 160°C, 170°C and 180°C for 5 min, 30 min and 1 hour. Effects of the reaction temperature and duration time on the phase evolution, the particle size and morphologies of BFO crystallites were systematically investigated.

Fig. 1, 2 and 3 shows XRD of BFO powders synthesized at 160°C, 170°C and 180°C respectively for 5 min, 30 min and 1 hour. Figure 3 X-ray diffraction results indicated that perovskite BFO crystallites have been synthesized at the temperature of 180°C for 1 hour using the KOH concentration of 4M. The ferroelectric Curie temperature of our hydrothermal BFO crystallites was determined by differential thermal analysis. The hydrothermal reactions to form crystalline BFO powders were discussed based on the dissolution–crystallization process.

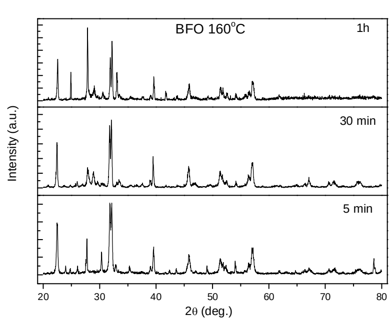

Figure 1: XRD of BFO powders synthesized at 160°C using different times.

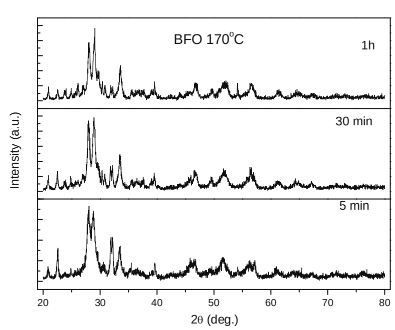

Figure 2: XRD of BFO powders synthesized at 170°C using different times.

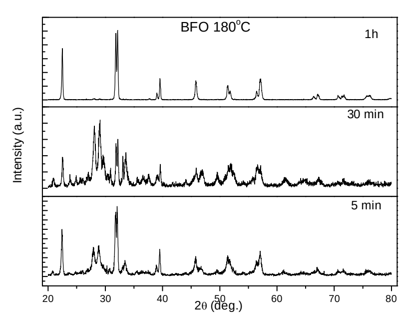

Figure 3: XRD of BFO powders synthesized at 180°C using different times.

References

[1] J.G. Ismilzade, Phys. Status Solidi (b) 46 (1971) K39.
[2] G.A. Smolenskii, V.M. Yudin, Sov. Phys. JETP 16 (1963) 622