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Synthesis of Pure $BiFeO_3$ (Bismuth Ferrite) Powder Samples Using Urea Fuel through Solution Combustion Method (SCM)

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Abstract:

This paper describes the synthesis of pure $BiFeO_3$ multiferroic ceramic samples using solution combustion method (SCM) using two different types of fuels. The $BiFeO_3$ ceramic powders was prepared using metal nitrates, urea and glycine fuels. These produced $BiFeO_3$ powder samples were grinded in an acetone media, calcined at higher temperatures and finally formation of pellets.

Keywords: Multiferroics, $BiFeO_3$, SCM, glycine, urea, applications.

INTRODUCTION:

At room temperature, multiferroic materials have been shown to concurrently display electric and magnetic ordering [1]. $BiFeO_3$ has ferroelectric Curie temperature T_C = 1103 K and G type antiferromagnetic Neel temperature T_N = 643 K [2]. The multiferroic $BiFeO_3$ have number of prime applications in different fields like high density microactuators [3], magnetic field sensors, detectors [4], multistate storage [5], technological applications [6], transducers [7], multiple state memory elements [8] and photosensitizers [9].

The pure, doped and codoped $BiFeO_3$ multiferroic materials have been prepared by number of synthesis techniques such as, Auto-combustion route [10], Sol-gel auto combustions method [11], solid state reaction [12], combustion method [13], citrate gel method [14] and citrate method [15].

This paper describes the formulation of multiferroic $BiFeO_3$ ceramic powder samples by solution combustion method.

EXPERIMENTAL PROCEDURE:

SYNTHESIS OF $BiFeO_3$ - GLYCINE SAMPLE:

The bismuth nitrate, ferric nitrate and glycine were used as an initial starting precursors. The preparation of $BiFeO_3$ sample was carried out using the precursors such as bismuth nitrate, ferric nitrate as an oxidizers while glycine was used as a fuel. In order to prepare the mixture of samples, the oxidizer (O) to

fuel (F) ratio was properly calculated using the oxidizing and reducing valences of the metal nitrates and fuel [16].

The bismuth nitrate, ferric nitrate and glycine taken in a stoichiometric quantity and were dissolved in a distilled water in a separate beakers after that, these solutions were mixed together and conveyed in a pyrex dish for heating on a gas burner. Afterwards the continuous heating, the water gets evaporated and finally a combustion takes place with formation of $BiFeO_3$ powder. The experimental procedure was reported by Chaudhari et.al. [17], the prepared powder was grinded in an acetone medium and finally calcined at 275^{o}C for 2 hours in a furnace and finally carried out for pellet formation. The following flowchart in Fig.1. shows the synthesis of $BiFeO_3$ powder sample using glycine fuel by solution combustion method.

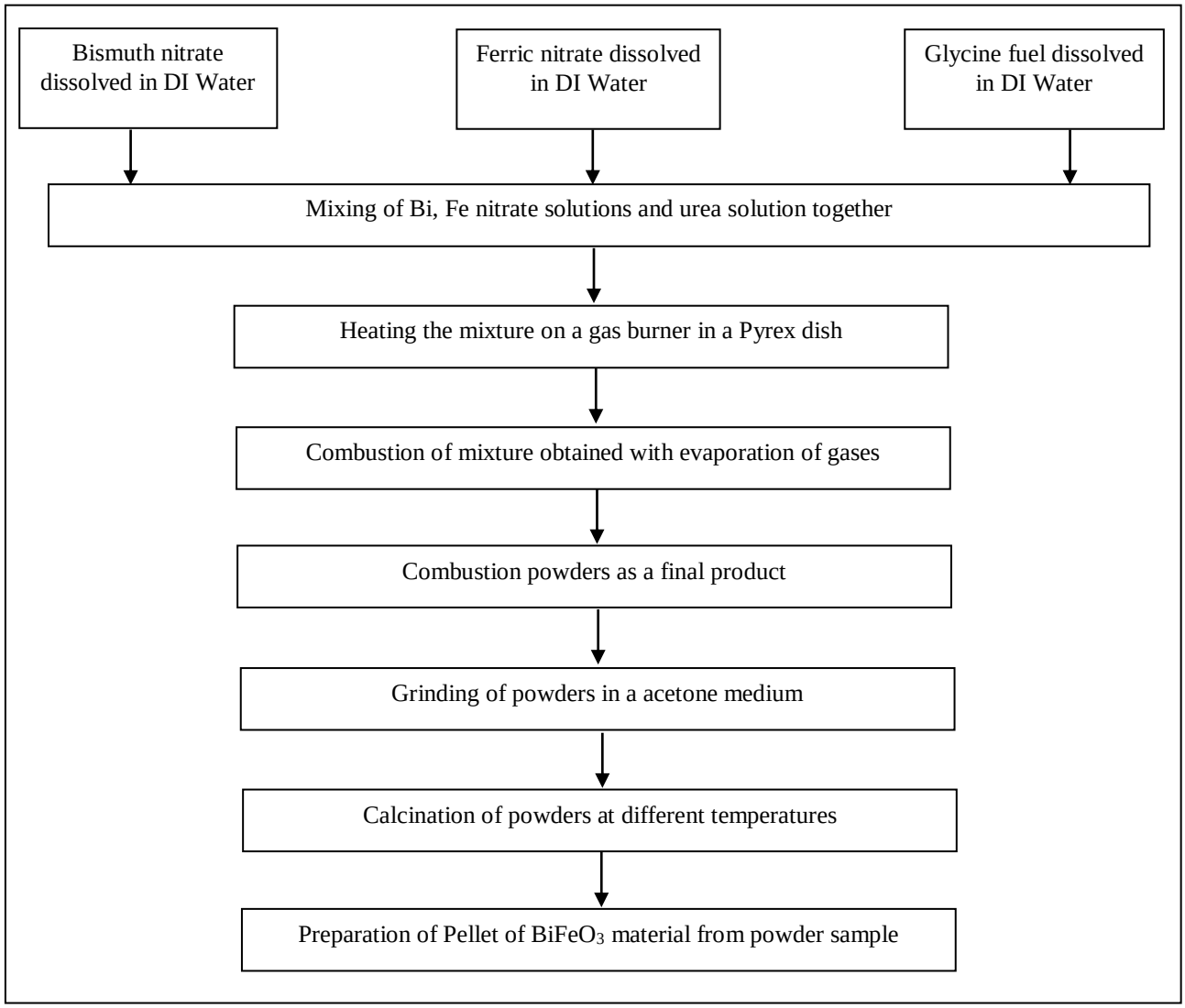

Fig.1. shows the flowchart of synthesis of $BiFeO_3$ powder sample using glycine fuel by solution combustion method.

SYNTHESIS OF $BiFeO_3$– UREA SAMPLE:

The bismuth nitrate, ferric nitrate and urea were used as an initial starting precursors. The preparation of $BiFeO_3$ sample was carried out using the precursors such as bismuth nitrate, ferric nitrate as an oxidizers while urea was used as a fuel. In order to prepare the mixture of samples, the oxidizer (O) to fuel (F) ratio was properly calculated using the oxidizing and reducing valences of the metal nitrates and fuel [16].

The bismuth nitrate, ferric nitrate and urea taken in a stoichiometric quantity and were dissolved in a distilled water in a separate beakers after that, these solutions were mixed together and conveyed in a pyrex dish for heating on a gas burner. Afterwards the continuous heating, the water gets evaporated and finally a combustion takes place with formation of $BiFeO_3$ powder. The experimental procedure was reported by Chaudhari et.al. [17], the prepared powder was grinded in an acetone medium and finally calcined at 300^oC for 2 hours in a furnace and finally carried out for pellet formation. The following flowchart in Fig.2. shows the synthesis of $BiFeO_3$ powder sample using urea fuel by solution combustion method.

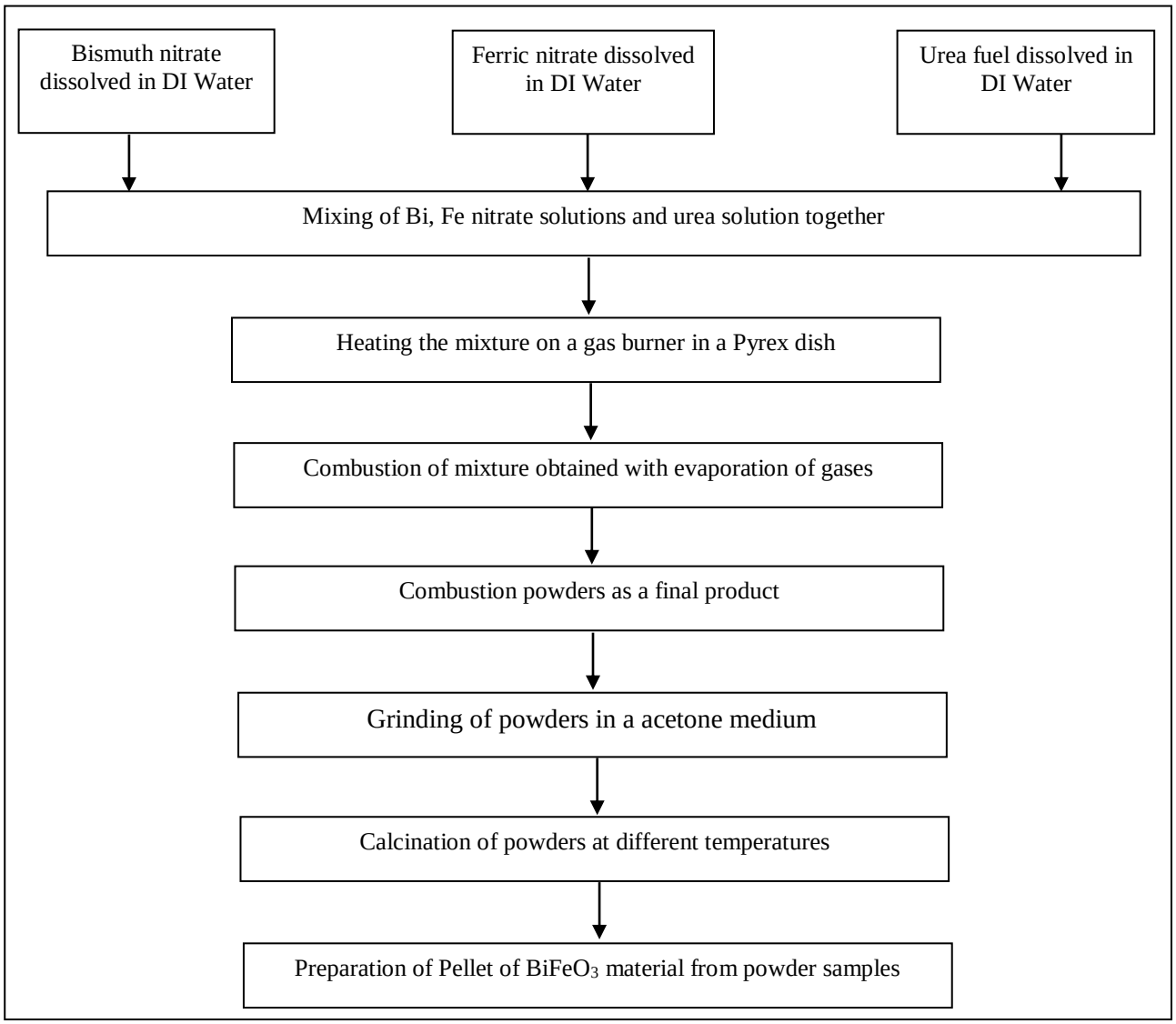

Fig. 2. shows the flowchart of synthesis of $BiFeO_3$ powder sample using urea fuel by solution combustion method.

Fig. 2 (a) Fig. 2 (b)

Fig. 3 (a) and Fig. 3 (b) shows the synthesized $BiFeO_3$ powder samples using glycine fuel and urea fuel

Fig. 4 (a) and Fig. 4 (b) shows the pellets of prepared $BiFeO_3$ powder samples using glycine fuel and urea fuel

RESULTS AND DISCUSSION:

Fig.1. and Fig.2. shows the flowchart of sample preparation of $BiFeO_3$ materials in powder form using glycine and urea fuels. These formulated powder samples were grinded in an acetone medium, calcined in a furnace at higher temperature of 275 ^oC and 300 ^oC for 2 hours and finally, the pellets were prepared from these powder samples.

CONCLUSION:

In the present paper, we have successfully synthesized the multiferroic $BiFeO_3$ powder samples using solution combustion method and formation of pellets. These prepared powder samples were calcined at higher temperatures.

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