

## Accepted Manuscript

Title: Optimising dopants and properties in  $\text{BiMeO}_3$  (Me = Al, Ga, Sc, Y,  $\text{Mg}_{2/3}\text{Nb}_{1/3}$ ,  $\text{Zn}_{2/3}\text{Nb}_{1/3}$ ,  $\text{Zn}_{1/2}\text{Ti}_{1/2}$ ) lead-free  $\text{BaTiO}_3$ - $\text{BiFeO}_3$  based ceramics for actuator applications

Authors: Shunsuke Murakami, Nihal Thafeem Ahmed Faheem Ahmed, Dawei Wang, Antonio Feteira, Derek C. Sinclair, Ian M. Reaney



PII: S0955-2219(18)30315-7  
DOI: <https://doi.org/10.1016/j.jeurceramsoc.2018.05.019>  
Reference: JECS 11897

To appear in: *Journal of the European Ceramic Society*

Received date: 9-3-2018  
Revised date: 15-5-2018  
Accepted date: 16-5-2018

Please cite this article as: Murakami S, Ahmed NTAF, Wang D, Feteira A, Sinclair DC, Reaney IM, Optimising dopants and properties in  $\text{BiMeO}_3$  (Me = Al, Ga, Sc, Y,  $\text{Mg}_{2/3}\text{Nb}_{1/3}$ ,  $\text{Zn}_{2/3}\text{Nb}_{1/3}$ ,  $\text{Zn}_{1/2}\text{Ti}_{1/2}$ ) lead-free  $\text{BaTiO}_3$ - $\text{BiFeO}_3$  based ceramics for actuator applications, *Journal of the European Ceramic Society* (2018), <https://doi.org/10.1016/j.jeurceramsoc.2018.05.019>

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

## Optimising dopants and properties in BiMeO<sub>3</sub> (Me = Al, Ga, Sc, Y, Mg<sub>2/3</sub>Nb<sub>1/3</sub>, Zn<sub>2/3</sub>Nb<sub>1/3</sub>, Zn<sub>1/2</sub>Ti<sub>1/2</sub>) lead-free BaTiO<sub>3</sub>-BiFeO<sub>3</sub> based ceramics for actuator applications

Shunsuke Murakami<sup>1</sup>, Nihal Thafeem Ahmed Faheem Ahmed<sup>1</sup>, Dawei Wang<sup>1</sup>, Antonio Feteira<sup>2</sup>, Derek C. Sinclair<sup>1</sup>, and Ian M Reaney<sup>1,\*</sup>

<sup>1</sup>Department of Materials Science and Engineering, University of Sheffield, Sheffield S1 3JD, UK

<sup>2</sup>Materials Engineering and Research Institute, Sheffield Hallam University, Sheffield S1 1WB, UK

\*Corresponding Author Prof. Ian M Reaney: i.m.reaney@sheffield.ac.uk

### Abstract

A crystallochemical framework is proposed based on electronegativity difference ( $e_n$ ) and tolerance factor ( $t$ ) to optimise the BiMeO<sub>3</sub> dopants and therefore the piezoelectric and electrostrictive response in BaTiO<sub>3</sub>-BiFeO<sub>3</sub> based ceramics. Compositions in the series 0.05Bi(*Me*)O<sub>3</sub>-0.25BaTiO<sub>3</sub>-0.7BiFeO<sub>3</sub> (*BMe*-BT-BF, *Me*: Y, Sc<sub>1/2</sub>Y<sub>1/2</sub>, Mg<sub>2/3</sub>Nb<sub>1/3</sub>, Sc, Zn<sub>2/3</sub>Nb<sub>1/3</sub>, Zn<sub>1/2</sub>Ti<sub>1/2</sub>, Ga, and Al) were fabricated using solid state synthesis and furnace cooled. Scanning electron microscopy and X-ray diffraction revealed that only Bi(Mg<sub>2/3</sub>Nb<sub>1/3</sub>)O<sub>3</sub> and BiScO<sub>3</sub> dopants, which lie in a narrow range of  $e_n$  vs.  $t$ , form homogeneous ceramics, free from secondary phases reflected in their superior piezoelectric coefficients ( $d_{33}$  ~145 pC/N). All other BiMeO<sub>3</sub> additions exhibited either secondary phases (Y) and/or promoted a two-phase perovskite matrix (Zn, Ga and Al). The promising initial properties of BiScO<sub>3</sub> doped compositions prompted further studies on 0.05BiScO<sub>3</sub>-(0.95- $x$ )BaTiO<sub>3</sub>-( $x$ )BiFeO<sub>3</sub> (BS-BT-BF,  $x$  = 0.55, 0.60, 0.625, 0.65, and 0.70) ceramics. As  $x$  increased the structure changed from predominantly pseudocubic to rhombohedral, resulting in a transition from a relaxor-like to ferroelectric response. The largest  $d_{33}^*$  (465 pm/V) was achieved for  $x$  = 0.625 under 5 kV/mm at the crossover from relaxor to ferroelectric behaviour. BS-BT-BF with  $x$  = 0.625 showed >0.3% strain under 6 kV/mm up to 175°C, demonstrating its potential for actuator applications.

Keywords: Lead-free piezoelectric ceramics

Download English Version:

<https://daneshyari.com/en/article/7897814>

Download Persian Version:

<https://daneshyari.com/article/7897814>

[Daneshyari.com](https://daneshyari.com)