Electrical and XRD Behavior Of $Ba(W_{0.70}Zr_{0.3})O_4$

Chandra Kumar Dixit[1], R. P Sharma[2] , Vinod Singh[3]
[1]Centre of material science, Dept. of Physics Feroze Gandhi Institute of Engineering and technology, Rae Bareli-U.P India 229001
[2] Dept. of Engineering, Feroze Gandhi Institute of Engineering and technology, Rae Bareli-U.P India 229001
[3]Dept. of Physics, K.S Saket PG College Ayodhya Faizabad,U.P India-224001

Abstract : **Barium zirconium tungstate ferroelectric ceramics modified with vanadium $Ba(W_{0.70} Zr_{0.10})O_4$ (BZW) had been ready from powders synthesized the usage of the mixed oxide method. The effect of temperature on the structural and electrical properties of BZW ceramics was once investigated. X-ray diffraction information evidenced no secondary phases. As temperature decreases, the maximum dielectric permittivity diminished. The superb-grained pattern showed a 'relaxor-like' ferroelectric conduct. Loss tangent and conductivity were additionally temperature dependent.**

Keywords: Dielectric constant, Dielectric loss, Curie temperature, Phase transition.

INTRODUCTION

$Ba[W_{0.70})Zr_{0.30}]O_4$ (BZW) cast solution has gained a lot attention because of its very good dielectric properties for practical application as capacitors. Maquerrie et al. were early X-ray crystalline construction studies discovered that BZW bureaucracy an entire forged solution [4]. A phase diagram was once due to this fact constructed for up to 30 at % Zr substitution in overdue Fifties. This ceramic is regularly used for making capacitors, and therefore so much research are focused at the temperature dependence of the dielectric constant, the nature of section transitions, and the relaxor conduct of this subject matter. Precise ferroelectric and piezoelectric behavior used to be less studied although one of the crucial piezoelectric houses was mentioned. On the other hand, the contemporary discovery at the very high piezoelectric d electro-strictive homes in lead containing relaxor ferroelectric single crystals has inspired a renewed pastime on the lookout for top pressure subject matters, particularly environmentally pleasant lead-free subject materials. $BaWO_3$ is a well known lead-loose ferro electrical material. The tension is as high as 1% within the form single crystals, however the hysteresis is quite huge, which blocks practical applications. it's recognized that doping is an effective way to sensible the material according to shapeance in electro-ceramics. -doped $BaWO_3$ unmarried crystals have been recently grown and display promising piezoelectrical and electrostrictive houses [5-24].

Such conduct would possibly lead to a few effects on the dielectric behavior via interaction with domain partitions [25, 26]. Similarity to Zr changed BW, BZW may be a promising subject material as lead-unfastened actuator. In earlier work, we have seen that the substitution of vanadium on B-web page broads the dielectrical constant habits of BZW ceramics. That can be caused by repulsion of vanadium with their subsequent close to-est associates resulting in a construction which is tetragonally distorted [27,28]. Properties of ceramic subject materials are considerably suffering from temperature, defects, setting go with the flow. We will need to keep an eye on the temperature due to its sturdy affect on the grain measurement, dielectric and ferro-electric residences [29–31]. The medium and fantastic-grained own terrible dielectrical properties influencing at the performance of the tool. That is because of the oxygen inter-diffusion, chemical reaction, or structural defects in this particle size range. In the present observe, a deep investigation on temperature dependence of electrical homes of BZW ceramics prepared by mixed oxide way was once performed.

2. EXPERIMENTAL PROCEDURE

Ba $(Zr_{0.300} W_{0.700})O_4$ ceramics have been ready by means of solid-state response. $BaCO_3$, WO_2 and ZrO_2 beginning fabrics with high purity were weighed and wet jumbled in alcohol. After drying, the powders have been calcined at 873 K for 4 h. An aqueous solution of vanadium used to be delivered to BZW powders. BZW have been sintered at 1473 K, 1573 K and 1623 K, respectively with pellets in a size of approximately 10 mm × 1 mm. The density of the sintered compacts used to be measured by way of Archimedes means. After sintering the disks had been polished to 1 mm in thickness and characterized by the use of electric measurements. Gold electrodes were applied through evaporation thru a sputtering gadget in a cultured floor of sintered discs. X-ray diffraction data have been collected with a Rigaku Rint 2000 diffractometer.

3. RESULTS AND DISCUSSION

Fig. 1 represents the room temperature X-ray diffraction development bought from the BZW ceramics sintered at more than a few temperatures. The X-ray reflections show that the only section with a tetragonal perovskite construction used to be bought. This is a clear indication that vanadium has shaped a strong cast resolution with the BZW lattice. The polycrystalline segment showed the best possible depth peak at $2\theta = 31^{\circ}$. Even though diffraction peaks comparable to the tetragonal perovskite construction had been detected at low temperature (1473 k), they were typically weak indicating a negative crystallinity of the ceramics in the (1 1 0) and (2 2 0) instructions. At 1623 K, the growth of (1 1 0) and (2 2 0)-oriented grains was cited. Some orientation-sensitive bodily properties, comparable to dielectric constant and remnant polarization should vary with the extent of blending of orientations that is different from one film to the other.

The temperature reliance of dielectric constant and dielectric misfortune tanδ for three specimens at 1,10 and 100 KHz is indicated in Fig. 2(a) and (b), separately. For coarse-grained specimen, the stage move is seen at 365 K, and its greatest dielectric for every constant (ε_m) 15,000. In this, specimen it was noted a structural stage move which compares to the move of paraelec-tric (cubic) to ferroelectric (tetragonal) stage (at Tc). The dielectric loss shows solid reliance as temperature expands. At the same recurrence area, they got qualities are 0.001 (1473 K) to 0.019 (1573 K and 1623 K). It is realized that the build of dissemination component is because of extraneous thunder behavior. This may be because of the imperfections (opening, movable ion, broken grain limit [35], and so forth.) that created in the structure of the mass material with the build of sintering temperature. The specimen sintered at low temperature has a huge difference in the dielectric misfortune crest recommending a squeeze off of stage transition. In this specimen, due the fine-grain microstructure the reduction of vanadium causes a more delicate bending of the perovskite grid prompting a lessening in the oxygen octahedron interstices. The mutilation of the perovskite cross section can fortify the structure vacillation of the BZW earthenware production, which might be mean distinctive conduct of dissemination stage move characterestics in this specimen.

In fig.3 shows the converse of dielectric permittivity as a capacity temperature measured at 10 KHz. It is seen that the dielectric permittivity of all examined earthenware production takes after the Curie–weiss law at temperatures much higher than the $T_{\varepsilon m}$.

Deviation from the Curie–Weiss law might be characterize

$$\Delta T_m = T_{cw} - T_{\varepsilon m}$$

4. CONCLUSIONS

BZW ceramics were ready from powders integrated utilizing the blended oxide system. Single stage ceramics solidified in a tetragonal structure was accomplished in the entire temperature range. The specimen sintered at 1623 K for 4 hr have a greatest dielectric permittivity of 15,000 at a Curie temperature equivalent to 366 K. The remanent polarization (Pr) and coercive electric field (Ec) of BZW ceramics were enhanced in the coarsed-grain pottery. Then again, for the fine-grained specimen, micropolar bunches exist and a run of the mill ferroelectric-relaxor trademark is displayed. The polarization conduct indicates that BZW earthenware production could be guaranteeing for dieletric and ferroelectric requisitions.

5. ACKNOWLEDGMENT

The authors thanks to Prof. A.K Srivastava for the valuable discussions on this paper.

5. REFERENCES

1. D. Hennings, A. Schnell, J. Am. Ceram. Soc. 65 (1982) 539.
2. D. Hennings, B. Schreinemacher, H. Schreinemacher, J. Eur. Ceram. Soc. 13 (1994) 81.
3. S.M. Neirman, J. Mater. Sci. 23 (1988) 3973.
4. M. McQuarrie, F.W. Behnke, J. Am. Ceram. Soc. 37 (1954) 539.
5. R.C. Kell, N.J. Hellicar, Acustica 6 (1956) 235.
6. T.N. Verbitshais, S.S. Zhdanov, Iu.N. Venevtsev, S.P. Solsviev, Sov. Phys. Crystal-logr.
3 (1958) 182.
7. J. Ravez, A. Simon, J. Solid State Chem. 34 (1997) 1199.
8. J. Ravez, A. Simon, Eur. Phys. J.: Appl. Phys. 11 (1997) 9.
9. R. Farhi, M. El Marssi, A. Simon, J. Ravez, Eur. Phys. J. B 9 (1999) 599.
10. J. Kuwata, K. Uchino, S. Nomura, Jpn. J. Appl. Phys., Part 1 21 (1982) 1298.
11. S.E. Park, T.R. Shrout, J. Appl. Phys. 82 (1997) 1804.
12. D.S. Paik, S.E. Park, S. Wada, S.F. Liu, T.R. Shrout, J. Appl. Phys. 85 (1999) 1080.
13. S.F. Liu, S.E. Park, T.R. Shrout, L.E. Cross, J. Appl. Phys. 85 (1999) 2810.
14. S.E. Park, S. Wada, L.E. Cross, T.R. Shrout, J. Appl. Phys. 85 (1999) 2746.
15. S. Wada, S. Suzuki, T. Noma, T. Suzuki, M. Osada, M. Kakihana, S.E. Park, L.E. Cross,
E. Burcsu, G. Ravichandran, K. Bhattacharya, Appl. Phys. Lett. 77 (2000) 1698.
16. T.R. Shrout, Jpn. J. Appl. Phys., Part 1 38 (1999) 5505.
17. Y. Zhi, R. Guo, A.S. Bhalla, J. Cryst. Growth 233 (2001) 460.
18. Y. Zhi, R. Guo, A.S. Bhalla, J. Cryst. Growth 233 (2001) 460.
19. Y. Zhi, R. Guo, A.S. Bhalla, J. Appl. Phys. 88 (2000) 410.
20. Y. Zhi, R. Guo, A.S. Bhalla, Appl. Phys. Lett. 77 (2000) 1535.
21. Y. Zhi, R. Guo, A.S. Bhalla, Ferroelectr. Lett. Sect. 27 (2000) 113.
22. Y. Zhi, A.J. Chen, P.M. Vilarinho, J.L. Baptista, J. Phys. 88 (2000) 410.
23. F. Moura, A.Z. Simões, L.S. Cavalcante, M. Zampieri, M.A. Zaghete, J.A. Varela, E. Longo, Appl. Phys. Lett. 92 (2008) 032905.
24. R. Shannigrahi, R.N.P. Choudhary, N. Acharya, Mater. Sci. Eng. B 56 (1999) 31.
25. D. Bolten, U. Bouger, T. Schneller, M. Grossnam, O. Lose, R. Waser, Appl. Phys. Lett. 77 (2000) 3830.
26. F. Moura, A.Z. Simões, L.S. Cavalcante, M.A. Zaghete, J.A. Varela, E. Longo, J. Appl. Comp. 466 (2008) L15.
27. F. Moura, A.Z. Simões, L.S. Cavalcante, M.A. Zaghete, J.A. Varela, E. Longo, J. Appl. Comp. 462 (2008) 129.
28. X.G. Tang, J. Wang, X.X. Wang, H.L.W. Chan, Solid State Commun. 131 (2004) 163.
29. A.Z. Simões, M.A. Ramirez, C.S. Riccardi, A. Ries, E. Longo, J.A. Varela, Mater. Chem. Phys. 92 (2005) 373.
30. L.G.A. Marques, L.S. Cavalcante, A.Z. Simões, F.M. Pontes, I.L.V. Rosa, J.A. Varela,
a. Longo, Mater. Chem. Phys. 105 (2007) 293.
31. Y. Zhi, A. Chen, R. Guo, A.S. Bhalla, J. Appl. Phys. 92 (2002) 2655.
32. M. Anicete-Santos, L.S. Cavalcante, E. Orhan, E.C. Paris, M.R. Joya, P.R. de Lucena, P.S. Pizani, E.R. Leite, J.A. Varela, E. Longo, Chem. Phys. 316 (2005) 260.
33. Chandra Kumar dixit and A.K Srivastava International Journal of physics and Research pp 1-4, Vol. 3 March 2013.
34. Chandra Kumar dixit and A.K Srivastava International Journal of electrical and electronics Engineering Research pp 25-32, Vol. 3 March 2013.

35. Chandra Kumar dixit and A.K Srivastava International Journal of Current Research pp. 299-302, Vol. 4 Dec. 2012.
36. Chandra Kumar dixit and A.K Srivastava International Journal of Theoretical and Applied Research (***Springer Open Journal***) pp. 2251-7235, Vol. 6-8 Jan-June 2012.

FIGURE CAPTION

Fig.1 x-ray diffraction of BZW ceramics sintered.

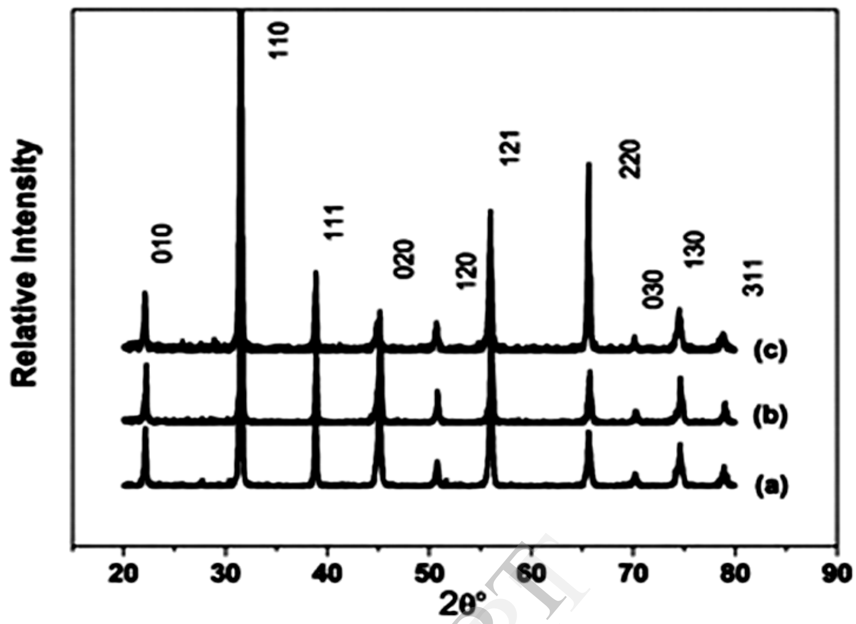
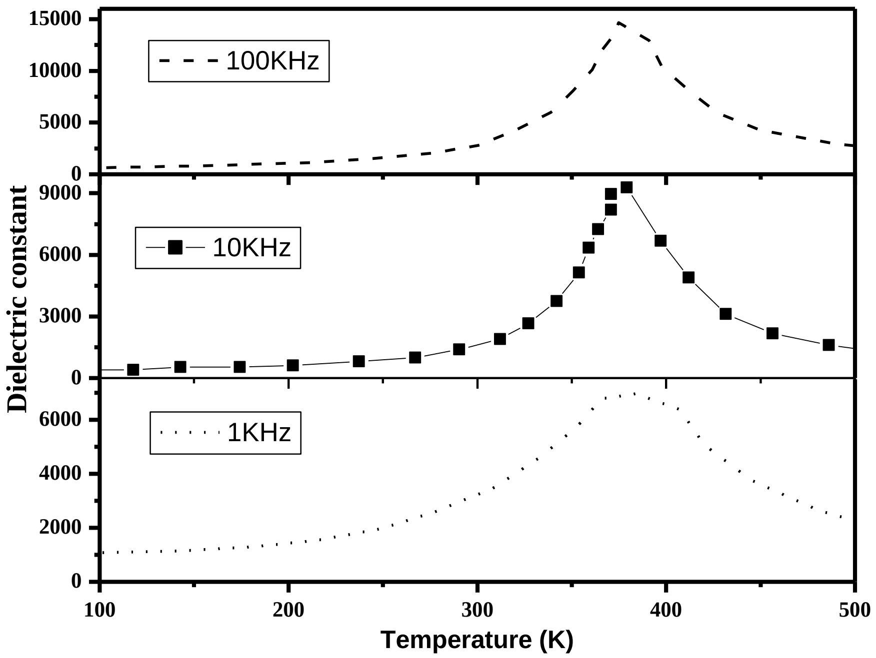


Fig.2 Temperature dependence of dielectric constant at 1KHz,10KHz and 100KHz



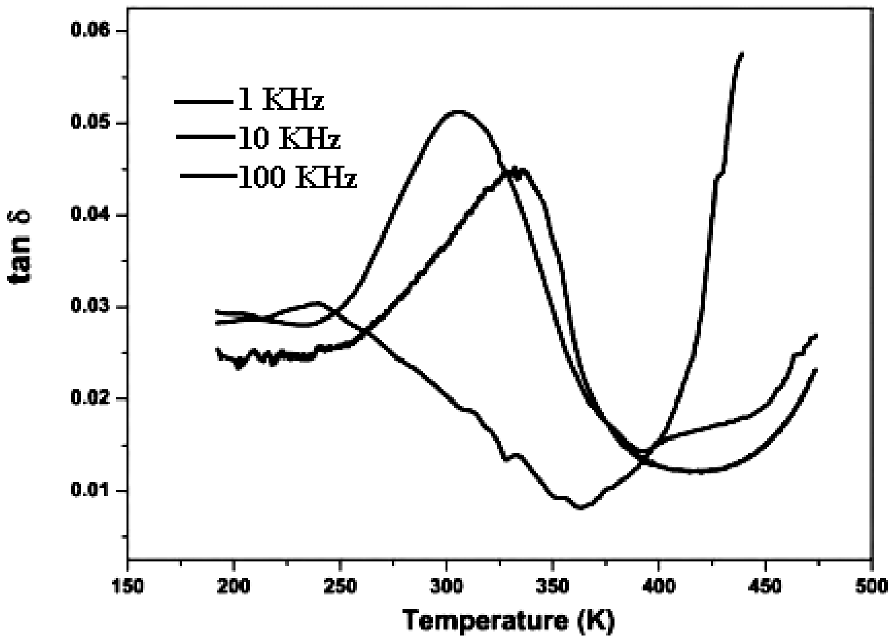


Fig.3 Inverse dielectric constant as a function of temperature (1473K, 1573K and 1673K).