低溫燒結pzt陶瓷在致動器方面的應用=low-temperature sintered pzt-based ceramics and their applications on actuators

謝政順、朱聖緣 ; 李中夏

E-mail: 8804787@mail.dyu.edu.tw

摘 要

PZT-based陶瓷，將以一般氧化物混合技術摻雜Bi2O3, Fe2O3, CuO, MnO2和Ba(Cu0.5W0.5)O3粉末，以930°C燒結並持溫90分鐘。所得到的介電常數大約是900，正切損失(tangent loss)則小於0.1%。從這裡可清楚地看出這些摻雜物對於降低燒結的溫度與改善介電常數有很大的幫助。其以低溫燒結而成的PZT-based陶瓷之微結構與組成分析將由XRD與SEM得到。我們亦以建立在Mason模型與Leach受控電源類比模型的傳輸線等效電路為基礎，成功的來模擬PZT-based壓電陶瓷換能器的行為。此模擬結果與實驗結果十分接近，故此模擬應用在設計壓電換能器上是非常有幫助的。 其次我們將以一般氧化物混合技術研製0.25Pb(Ni1/3Nb2/3)O3-0.75Pb(Zr0.5Ti0.5)O3 (PNN-PZT)壓電陶瓷，並摻雜BiFeO3與Ba(Cu0.5W0.5)O3氧化粉末，以850℃ ~ 950°C燒結以得到較佳之壓電特性。其以低溫燒結而成的PNN-PZT-based陶瓷之微結構與組成分析將由XRD與SEM得到。PNN-PZT陶瓷在摻雜後對燒結溫度與介電特性的影響在本文中將被研究，我們發現 這些摻雜物對於降低燒結溫度與改善介電特性有很大的幫助。且其最佳燒結條件將在本文中被探討。

關鍵詞 : 鋯鈦酸鉛陶瓷 ; 低溫燒結

目錄

參考文獻

1. B. Jaffe, W. Cook, Tr., and H. Jaffe, Piezoelectric Ceramics, Academic Press New York, 1971. 2. B. Jaffe, “ Piezoelectric Transducers Using lead Titanate and Lead Zirconate, ” U. S. Pat. 2, 708, 244 (1955). 3. B. Jaffe, “ morphotropic Piezoelectric Ceramics, ” U. S. Pat. 2, 849, 404 (1958). 4. F. Kulcsar, F. Park, and W. R. Cook, Jr., “ Piezoelectric Wave Filter Ceramics, ” U. S. Pat. 3, 179, 594 (1965). 5. A. Lungo, M. Heights, and D. E. Bonnemn, M. Heifhts, “ Lead Zirconate-Titanate Containing Manganese Additive, ” U. S. Pat. 3, 549, 536 (1970). 6. T. R. Shrout, B. Jones, J. V. Biggers, and J. H. Adair, “ Enhanced Processing of Peroskite Pb(Mg1/3Nb2/3)O3 Relaxors through Understanding the Surface Chemistry of the Component Powders, ” CERAMIC POWDER SCIENCE II, B, The American Ceramic-Society, Inc., p. 519-527, (1988). 7. J. P. Guha, and H. U. Auderson, “ Processing-Property Relations of Peroskite-Based Solide Solutions in the System Pb(Fe1/2Nb1/2)O3-Pb(Fe2/3W1/3)O3 ” CERAMIC POWDER SCIENCE III, The American Ceramics-Society, Inc., p. 709-716 (1990). 8. M. Lejeune, J. P. Boilot, “ Low Firing Dielectrics Base on Lead Magnesium Niobate, ” Mat. Res. Bull. Vol. 20, pp. 493-499 (1985). 9. D. Dong, M. Xiong, K. Murakami and S. Kaneko, “ Lowering of Sintering Temperature of Pb(Zr,Ti)O3 Ceramics by the Addition of BiFeO3 and Ba(Cu0.5W0.5)O3, ” Ferroelectrics, Vol. 145 p. 125-133 (1993). 10. A. J. Moulson and J. M. Herbert, “ Electrical Materials Properties Applications, ” Chapter 6, 1990. 11. B. Jaffe, W. R. Cook, and H. Jaffe, “ Piezoelectric Ceramics, ” p. 25. 12. W. P. mason edited, “ physical Acoustics, ” p. 194-5. 13. W. Marshall Leach, “ Controlled-Source Analogous Circuits and SPICE models for Piezoelectric Transducers, ” IEEE Trans. On Ultrasonics, Ferroelectrics and Frequency Control, Vol. 41, No. 1, p. 60-66, January (1994). 14. W. P. Mason, Electromechanical Transducers and Wave Filter, Van Nostrand, Princeton (1948). 15. M. Redwood, J. Acoust. Soc. Am. 33, 527 (1961). 16. C. S. Hsieh, and J. M. Yan, C. H. Lee, S. L. Chen and S. Y. Chu, “ The Analysis and Design of Low-Temperature Sintered PZT-Based Transducers Using PSPICE, ” Proc. Of The 1998 Annual Conf. Of The Chinese Soc. For Mat. Sci. vol, K, p. 97-100. 17. C. S. Hsieh, and S. Y, Chu, “ Doping Effects on The Piezoelectric Properties of Low Temperature Sintered PZT-based Ceramics, ” Journal of Materials Science Letters., code 5459-99, it was

accepted. 18. S. Kaneko, D. Dong, and K. Murakami, “ Effect of Simultaneous Addition of BiFeO3 and Ba(Cu0.5W0.5)O3 on Lowing of Sintering Temperature of Pb(Zr,Ti)O3 Ceramics, ” J. Am. Ceram. Soc., 81 [4] 1013-18 (1998). 19. C. S. Hsieh, and S. Y. Chu, “ The Piezoelectric Properties of Low-Temperature Sintered PNN-PZT-Based Ceramics and Their Applications, ” Integrated Ferroelectrics., it was accepted.