English
Research Express@NCKU Volume 24 Issue 9 - September 13, 2013
[http://research.ncku.edu.tw/re/articles/e/20130913/4.html]

Dielectric Properties of High-Q $(Mg_{1-x}Zn_x)_{1.8}Ti_{1.1}O_4$ Ceramics at Microwave Frequency

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Journal of the European Ceramic Society, Vol. 32, No. 10,2365-2371 (2012)

$(Mg_{1-x}Zn_x)_{1.8}Ti_{1.1}O_4$ (x = 0.03–1.00) ceramics were prepared via the conventional solid-state method and their dielectric properties were investigated in the microwave frequency region. Formation of solid solutions was confirmed by the X-ray diffraction analysis, the EDX analysis, and the measured lattice parameters. A small amount of Zn substitution for Mg produced a large increase in $Q\times f$ due to a high packing fraction as well as a high relative density of the ceramics. By increasing x from 0.00 to 0.06, the $Q\times f$ of the specimen could be tremendously improved from 141,000 to a maximum of 210,700 GHz (at 10.52 GHz), demonstrating an unique potential for low-loss microwave applications. The τ_f values were found to retain in the range from –54.2 to –62.3 ppm/ ^oC for all compositions because the resultant change of unit cell volume was small. Also, a remarkable lowering of the sintering temperature down to ~300 ^oC was observed when Mg was totally substituted by Zn, thereby making it possible for low firing applications.

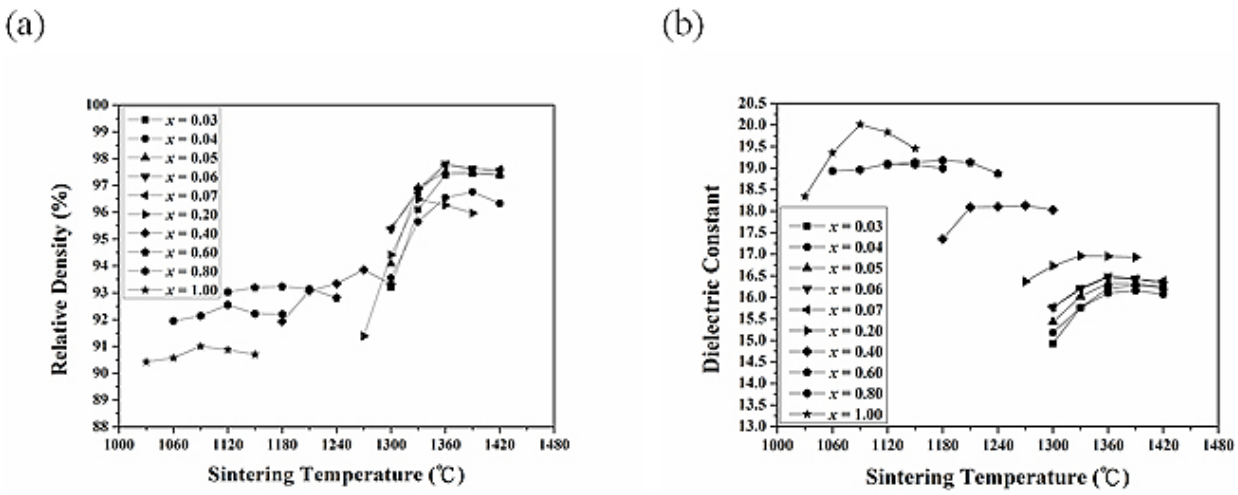

Fig. 1(a). Relative density of $(Mg_{1-x}Zn_x)_{1.8}Ti_{1.1}O_4$ (x = 0.03–1.00) ceramic system sintered at different temperatures for 4 h; Fig. 1(b). Dielectric constant of $(Mg_{1-x}Zn_x)_{1.8}Ti_{1.1}O_4$ (x = 0.03–1.00) ceramic system sintered at different temperatures for 4 h.

(a) (b)

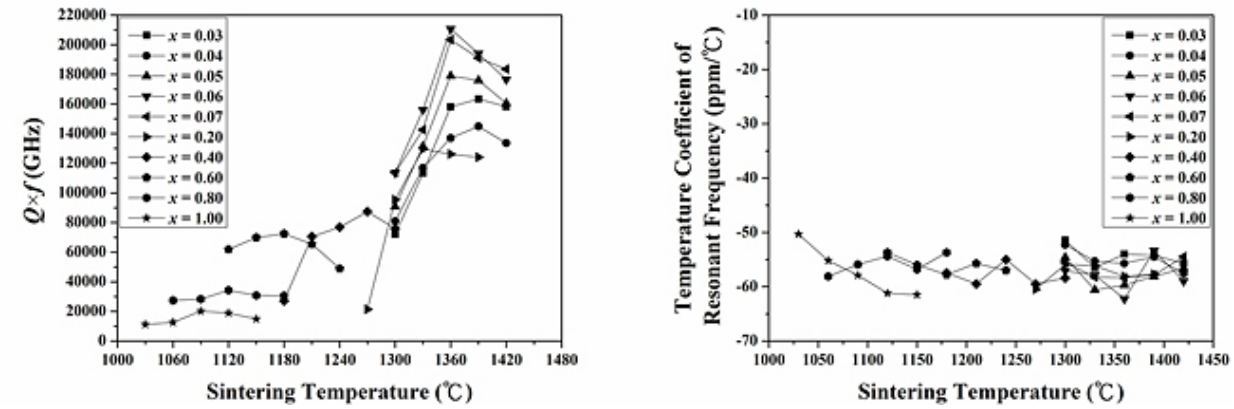

Fig. 2(a). $Q \times f$ values of $(Mg_{1-x}Zn_x)_{1.8}Ti_{1.1}O_4$ (x = 0.03–1.00) ceramic system sintered at different temperatures for 4 h; Fig. 2(b). τ_f values of $(Mg_{1-x}Zn_x)_{1.8}Ti_{1.1}O_4$ (x = 0.03–1.00) ceramic system sintered at different temperatures for 4 h.