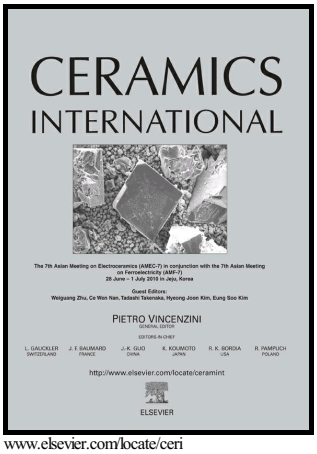

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Co_2O_3 substitution effects on the structure and microwave dielectric properties of low-firing $(Zn_{0.9}Mg_{0.1})TiO_3$ ceramics

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Co_2O_3 substitution effects on the structure and microwave dielectric properties of low-firing $(Zn_{0.9}Mg_{0.1})TiO_3$ ceramics

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Abstract

Low-firing $(Zn_{0.9}Mg_{0.1})_{1-x}Co_xTiO_3$ (x = 0.02 ~ 0.10) (ZMC_xT) microwave dielectric ceramics with high temperature stability were synthesized *via* conventional solid-state reaction. The influences of Co_2O_3 substitution on the phase composition, microstructure and microwave dielectric properties of ZMC_xT ceramics were discussed. Rietveld refinement results show the coexistence of $ZnTiO_3$ and ZnB_2O_4 phases at x = 0.02 ~ 0.10. $(Zn_{0.9}Mg_{0.1})_{1-x}Co_xTiO_3$ ceramic with x = 0.06 ($ZMC_{0.06}T$) obtains the best combination microwave dielectric properties of: ε_r = 21.58, $Q\times f$ = 53,948 GHz, τ_f = -54.38 ppm/^{o}C. For expanding its application in LTCC field, 3 wt. % $ZnO-B_2O_3-SiO_2$ (ZBS) and 9 wt. % TiO_2 was added into $ZMC_{0.06}T$ ceramic, great microwave dielectric properties were achieved at 900^{o}C for 4 h: ε_r = 26.03, $Q\times f$ = 34,830 GHz, τ_f = -4 ppm/^{o}C, making the composite ceramic a promising candidate for LTCC industry.

Key words: $(Zn_{0.9}Mg_{0.1})TiO_3$, Co_2O_3, $ZnO-B_2O_3-SiO_2$, microwave dielectric ceramics, low temperature sintering, LTCC

1. Introduction

High frequency passive components such as microwave dielectric resonators and antenna have been rapidly developed for cellular phones and global positioning systems in the past decades. Low temperature co-fired ceramics (LTCC) technology has been playing a significant role in this field. Requirements for these dielectric components must combine excellent dielectric properties such as a moderate dielectric constant (ε_r), a low dielectric loss of the quality factor ($Q\times f$) and a near-zero temperature coefficient of resonant frequency (τ_f), which allows the components to operate normally under a wide temperature range[1-3].

$ZnO-TiO_2$ based ceramics have been one favorite research for years because of their excellent microwave dielectric properties. In their phase diagram reported by Yang and Swisher[4], three phases