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Dielectric Characteristics of Zn2(Sn1-xTix)O4 Ceramics at Microwave Frequency for Application in 5G Communication Components

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Abstract

In evaluating substrates for 5G communication components, three of their dielectric properties must be considered; optimized dielectric constant, high quality factor, and temperature coefficient of a resonant frequency close to zero. A dielectric constant ($\square_r$) of 10.2, a quality factor ($Q\square f$) of 39,000 GHz, and a temperature coefficient of resonant frequency ($\square_f$) of -84.8 ppm/ ^{O}C were

obtained when Zn_2SnO_4 ceramics were sintered at 1225 ^{O}C for 4 h. The series of $Zn_2(Sn_{1-x}Ti_x)O_4$ microwave ceramics were investigated. Specimens were prepared by the conventional mixed-oxide method. The microwave dielectric characteristics of $Zn_2(Sn_{1-x}Ti_x)O_4$ ceramics are determined using X-ray diffraction (XRD) patterns, Rietveld refinement, and Raman spectra. As the degree of substitution of Ti^{4+} increases, the position of the A_{1g}(O) Raman mode shifts toward a higher frequency. The $Zn_2(Sn_{0.97}Ti_{0.03})O_4$ exhibits a minimum full width at half maximum (FWHM) for the A_{1g}(O) Raman vibration mode. At x=0.03, a dielectric constant of 9.8, a quality factor ($Q\square f$) of 47,200 GHz were achieved with a temperature coefficient at the resonant frequency ($\square_f$) of

-93.1 ppm/^{O}C. The dielectric constant of $Zn_2(Sn_{1-x}Ti_x)O_4$ ceramics depends on the relative density, ionic polarization, and the Raman shift for the A_{1g}(O) mode. The quality factor for $Zn_2(Sn_{1-x}Ti_x)O_4$ ceramics are determined by the FWHM for the A_{1g}(O) mode. Their moderate dielectric constant and high quality factor made them potentially very effective for use in 5G communication devices.

Keywords: $Zn_2(Sn_{1-x}Ti_x)O_4$; Microwave Dielectric Ceramic.