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Chemical substitution in spinel structured $LiZnNbO_4$ and its effects on the crystal structure and microwave performance

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Abstract:

$LiZn_{1-x}M_xNbO_4$ (M=Co, Ni) (x=0-0.06) systems were fabricated by a facile solid-state reaction method. Structure and property relationships of spinel structured $LiZn_{1-x}M_xNbO_4$ were investigated systematically. Appropriate amount of Co^{2+} and Ni^{2+} greatly improved the dielectric loss of $LiZnNbO_4$ ceramics. While, the dielectric loss deteriorated seriously when the doping content exceeded x=0.02. The origin of dielectric loss in $LiZn_{1-x}M_xNbO_4$ ceramics was investigated systematically. Moreover, the theoretical dielectric constant and linear expansion coefficient were calculated on the bases of the crystallographic parameters from XRD refinement. The temperature coefficient of resonant frequency calculated by the P-V theory agreed well with the test values. Due to the small doping content, the change in chemical bonds was negligible. Density became the major factor determining the variation of dielectric constant in $LiZnNbO_4$ ceramics. At last, excellent microwave dielectric properties were obtained: Ts=1010^oC, ε_r=15.25, Qf=107,000GHz, τ_f=-63.3ppm/^oC for $LiZn_{0.98}Co_{0.02}NbO_4$ and Ts=995^oC, ε_r=14.85, Qf=104,000GHz, τ_f=-61.7ppm/^oC for $LiZn_{0.98}Ni_{0.02}NbO_4$.

Keywords: Lattice vibration; Raman; Dielectric loss; Band gap; Linear expansion coefficient

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