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High-performance (1-x)(0.2B_2O_3–0.8SiO_2)–xTiO_2 (x = 0.025–0.1) glass matrix composites for microwave substrate applications

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ABSTRACT

The (1-x)(0.2B_2O_3–0.8SiO_2)–xTiO_2 (x = 0.025–0.1) glass matrix composites were prepared by a solid state sintering method, and high relative density >97% was obtained when the sintering temperature was 975–1000^{o}C. The rutile and amorphous phases were indicated by XRD, and no crystallization of amorphous SiO_2 or chemical reaction was observed. With increasing x from 0 to 0.1, the dielectric constant (ε_r) increased slightly while the *Qf* value decreased, and the temperature coefficient of resonant frequency (τ_f) increased from a negative to a positive value. The optimized microwave dielectric properties were obtained as following: ε_r = 4.01, *Qf* = 66,800 GHz, τ_f = -2.2 ppm/^{o}C for x =0.025 sintered at 1000^{o}C, and ε_r = 4.22, *Qf* = 55,300 GHz, τ_f = 3.1 ppm/^{o}C for x = 0.05 sintered at 975^{o}C. The ultra-low ε_r, high *Qf* value and near-zero τ_f indicate that the present glass matrix composites are excellent candidates as the microwave substrate materials.

KEYWORDS: glass matrix composite; fused silica; microwave substrate

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