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High-Q dielectrics using ZnO-modified Li_2TiO_3 ceramics for microwave applications

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The microwave dielectric properties of the (1–*x*)Li_2TiO_3–*x*ZnO (*x* = 0.1–0.5) ceramic system prepared by mixed oxide route have been investigated. The rock-salt structured (1–*x*)Li_2TiO_3–*x*ZnO were characterized by using X-ray diffraction spectra, scanning electron microcopy (SEM). The dielectric properties are strongly dependent on the compositions, the densifications and the microstructures of the specimens. The decrease of $Q\times f$ value at high-level ZnO addition ($x > 0.3$) was owing to the intensity of the (002) superstructure reflection decreased and became disordered rock-salt structure. For practical applications, a new microwave dielectric material 0.7 Li_2TiO_3–0.3ZnO is suggested and it possesses a good combination of dielectric properties with an ε_r of ~ 22.95, a $Q\times f$ of ~ 99,800 GHz (measured at 8.91 GHz), and a τ_f of ~ 0 ppm/°C. A low-loss dielectric resonant antenna using aperture-coupled cylindrical dielectric resonant was designed and fabricated using the proposed dielectric to study its performance.

Table 1 Microwave Dielectric Properties of (1–*x*)Li_2TiO_3–*x*ZnO Ceramic System Sintered at Different Temperatures for 2 h.

x value	Relative density (%)	ε_r	$Q\times f$ (GHz)	τ_f (ppm/°C)	Sintering temperature (°C)
0.0*	93.5	22.00	63,500	20.3	1300°C
0.1	89.9	22.86	88,500	23.7	1270°C
0.2	90.4	23.09	109,800	15.7	1270°C
0.3	90.1	22.95	99,800	0.0	1270°C
0.4	88.6	22.40	56,400	–25.8	1240°C
0.5	81.4	21.71	3,300	–16.1	1150°C

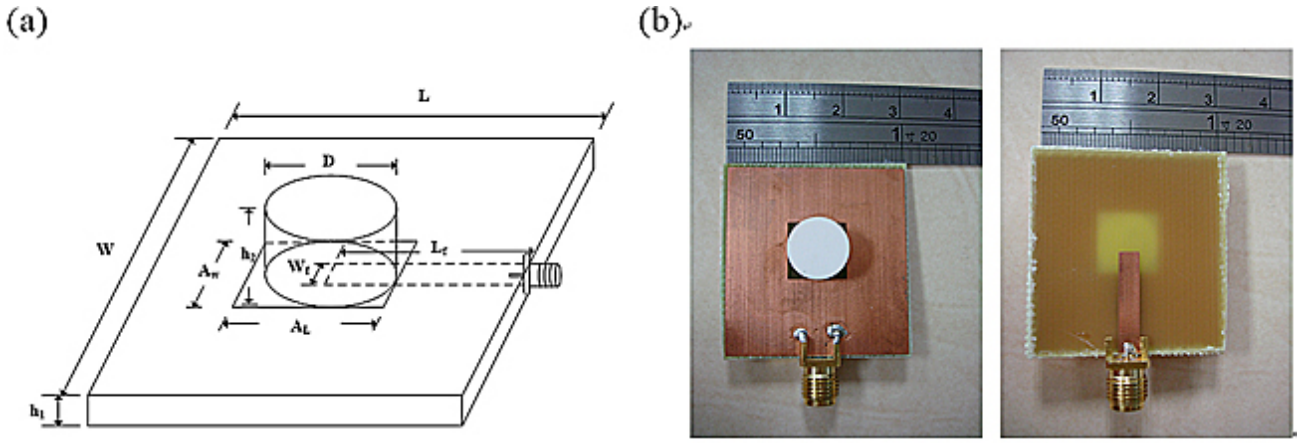

Fig.2. (a) Physical layout of the low-loss dielectric resonant antenna using aperture-coupled cylindrical DR antenna fed with microstrip line and fabricated aperture-coupled cylindrical DR antenna: (b) top and bottom view.

(c).

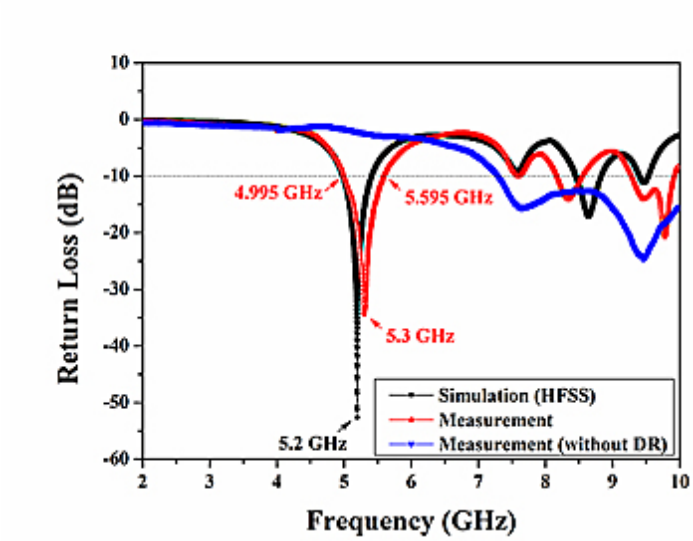

Fig. 2. (c) The simulation and measurement return loss of DR antenna fed with microstrip line.