2013
WISBAL 實驗室成員回娘家
之經驗交流與回顧分享

博班研究精華

題目:

Measurement Thickness or Permittivity Variations in Multilayered Dielectric Structures by Using Complementary Split Ring Resonator

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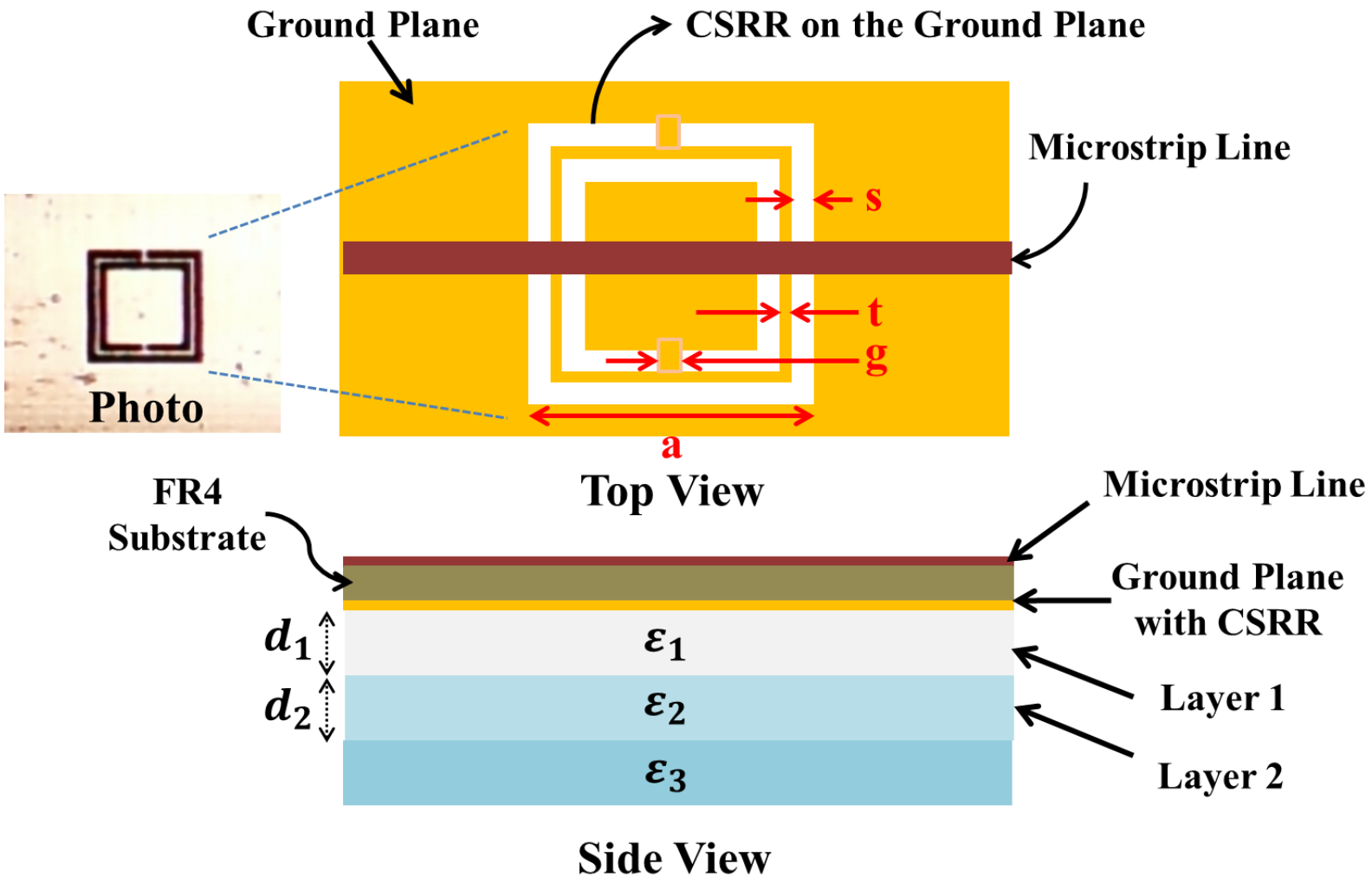
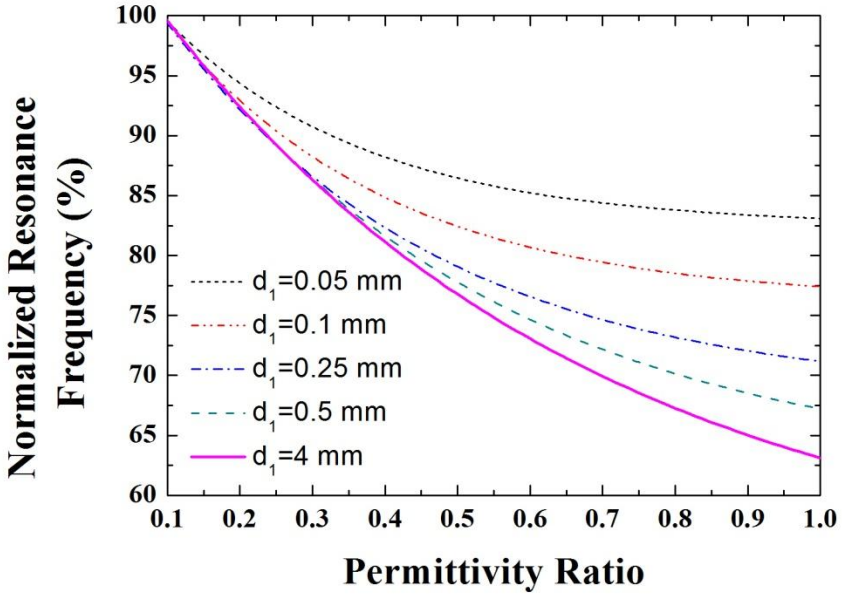
CSRR detection multi-dielectric layer experimental setup



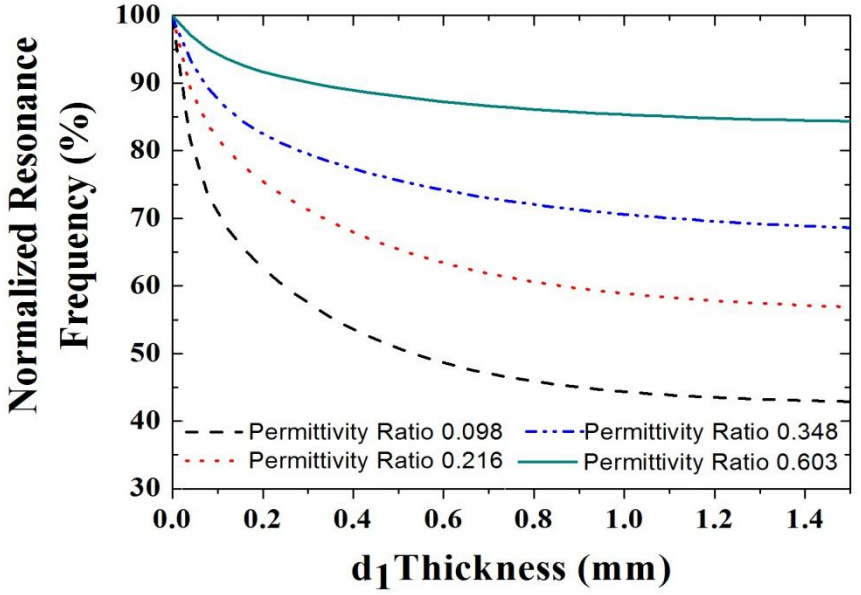
Analysis of the Sensor with Sample

Permittivity Variations



- Behavior the CSRR sensors as a function of dielectric ratio($\varepsilon_1/\varepsilon_2$)
  - with d_2=2mm, ε_2=10.2 case.
- The shift resonance frequency of the sensors are normalized with respect to the resonance frequency when medium ε_1 is 1
  - for each d_1=0.05 , 0.1 , 0.25 , 0.5 and 4 , six cases

Thickness Variations



- Behavior the CSRR sensors as a function of d_1 thickness
  - with d_1 + d_2=4mm
- The shift resonance frequency of the sensors are normalized with respect to the resonance frequency when d_1=0 of the medium
  - in four different permittivity ration 0.098 , 0.216 , 0.348 , 0.603 cases

TABLE I.
CSRR DIMENSION FOR NUMERICAL ANALYSIS
t=g=0.2mm

	Case A	Case B	Case C	Case D	Case E
a(mm)	3.5	6	13	6	6
s (mm)	0.4	0.4	0.4	0.2	0.7
f_o(GHz)	3.83	1.65	0.69	1.77	2.04

TABLE II.
PERMITTIVITY RESOLUTION ANALYSIS
$d_1 + d_2$= 4mm, t=g=0.2mm, ε_2=10.2, $\Delta\varepsilon_1$=0.01,

d_1 (mm)	0.25			1.5		
ε_1	2.2	3.55	6.15	2.2	3.55	6.15
Case A (%)	0.035	0.019	0.010	0.063	0.047	0.031
Case B (%)	0.026	0.014	0.007	0.059	0.043	0.028
Case C (%)	0.022	0.012	0.006	0.057	0.040	0.026
Case D (%)	0.030	0.016	0.009	0.060	0.045	0.030
Case E (%)	0.026	0.014	0.007	0.059	0.043	0.028

TABLE III.
THICKNESS RESOLUTION ANALYSIS
$d_1 + d_2$= 4mm, t=g=0.2mm, ε_2=10.2, Δd_1=0.01

ε_1	3.55			6.15		
d_1 (mm)	0.05	0.25	1.5	0.05	0.25	1.5
Case A (%)	0.875	0.295	0.024	0.623	0.186	0.018
Case B (%)	0.652	0.288	0.028	0.451	0.179	0.022
Case C (%)	0.637	0.238	0.051	0.387	0.169	0.023
Case D (%)	0.711	0.283	0.026	0.499	0.186	0.022
Case E (%)	0.613	0.276	0.037	0.368	0.169	0.025

Conclusion

- A rectangular CSRR structure is etched out on the ground plane of a microstrip line as a sensor to measure thickness and dielectric of multi-layers was designed, fabricated and tested.
  - The sensor is based on the shift in the minimum transmission coefficient of the stop-band filter as a function
  - The optimized sensor design can provide better sensitivity in two thin cognate permittivity coincident layer.
- And the CSRR provide effective sensing and is easy integrated in microwave circuits