

에치홀의 위치와 희생층의 잔류물이 전송선 필터 응답에 미치는 영향

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Effect of Etch Hole Position and Sacrificial Layer Residue on a Novel Half-Coaxial Transmission Line Filter

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Abstract - In this paper, we present the effect on a novel transmission line filter response by the etch hole position on the suspended ground and the residue on the resonator under ground plane. We defined the etch hole offset as the distance from the sidewall of the suspended ground to the nearest side of the etch holes. We simulated new filter responses to reflect the real value of the changed etch hole offset caused by characteristics of negative photoresist. Return loss is distorted by the residue on the center conductor remained after sacrificial layer removing. By comparison of simulation and measurements, we concluded the residue on the resonator distorted the RF response worse than etch hole offset variation did.

1. 서 론

We fabricated a novel type of half-coaxial transmission line filter superior to bulk micromachined RF filter [1, 2] and showed a rough tendency of the etch hole effect on the filter response [3]. The measured return loss was degraded compared to the simulation and the center frequency was slightly shifting from a designed frequency as the etch hole offset increases (Fig. 1).

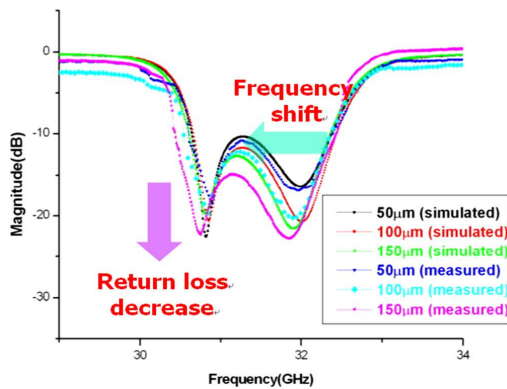


Fig. 1. Effect of offset on the RF responses

Though RF responses had a kind of tendency, a loss and a center frequency were not exactly the same as those of the simulation. Therefore, it is necessary to find out the reason why the measured response did not meet exactly with the designed simulation curve in wide range of the frequency.

2. 본 론

2.1 Etch Hole Position

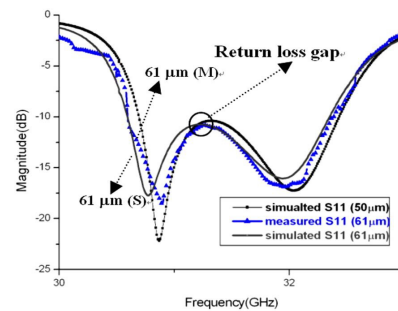
One of the reasons for this mismatching between measurements and simulations is that the actual offset value is not the same as the designed one. We defined the etch hole offset as the distance from the sidewall of the suspended ground

to the nearest side of the etch holes (Fig 2).

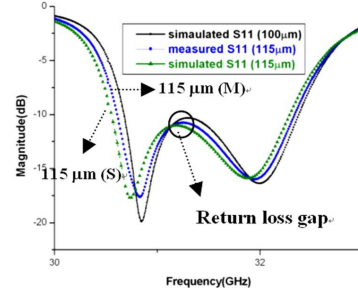


Fig. 2. Fabricated filter and definition of etch hole offset

The molds for the suspended ground plane were patterned by JSR-151 N negative photoresist [3]. After molds were stripped the etch holes were located at the very position of these molds. Mold pattern showed a negative sidewall profile on the surface of the sacrificial layer. It changed the real value of the side lengths of the etch hole thus altered the actual etch hole position. Designed offsets such as 50 and 100 μm turned out to be 61 and 115 μm .



(a) Filter responses with 61 μm offset.



(b) Filter responses with 115 μm offset.

Fig. 3. A comparison of RF responses

We simulated filter responses again to reflect the real value of etch hole offset above. The measurements are more similar to the new simulation than the previous one (Fig. 3).

The filter with 61 μm offset shows return loss of -10.81 dB , which is 0.07 dB lower than that of the new simulation. The difference of center frequency was only 0.03 GHz compared with the new simulation. The insertion loss was not quite different from the newly simulated result. The measured response graph better coincides with the simulated one all over the frequency. The responses for the filter with $115\text{ }\mu\text{m}$ offset also showed the better curve matching. When we focus on a return loss, the difference of return loss of a filter having $115\text{ }\mu\text{m}$ offset was larger than that of a filter having $61\text{ }\mu\text{m}$ offset. We can conclude the variation of the etch hole offset nearer to the center conductor affects much more on the response.

2.2 Sacrificial Layer Residue

Another reason for the mismatching between measurements and simulation is the residue on the resonator underneath the ground. When there is residue on the resonator, return loss graph is distorted compared with that of a filter without residue (Fig. 4).

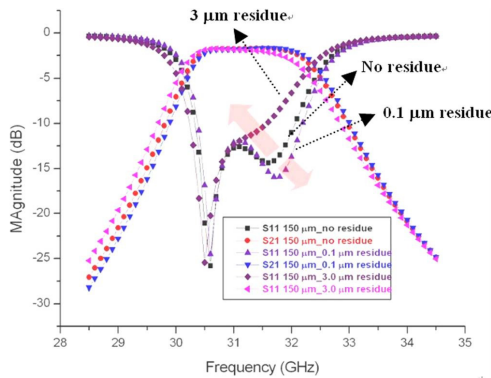
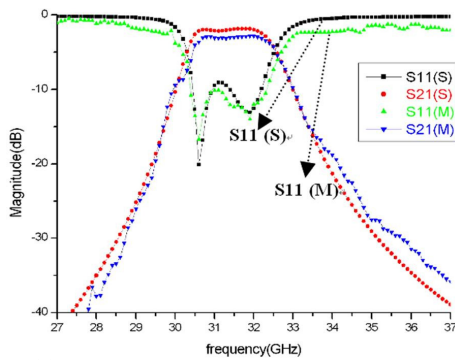
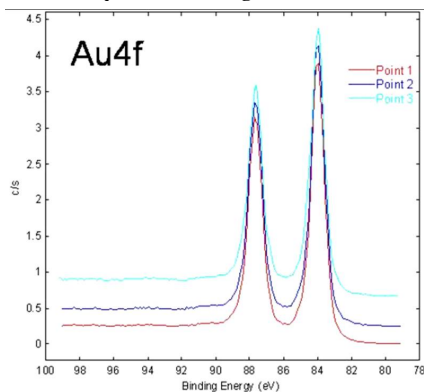


Fig. 4. Simulated effect of residue on the resonator gap



(a) RF response matching without residue



(b) XPS analysis on the resonator

Fig. 5. RF responses and XPS analysis of filter without residue on the center conductor

Small amount of residue ($0.1\text{ }\mu\text{m}$ thick) will make the second ripple move lower-right. Large amount of residue ($3\text{ }\mu\text{m}$ thick) is expected to distort the RF response itself. We confirmed the sacrificial layer remove process and could get filters without residue on the resonator.

Fig. 5 show the responses of a filter where sacrificial layer was fully removed and X-ray Photoelectron Spectroscopy (XPS) result shows that there is no remained sacrificial layer on the resonator surface except gold element. There were many filter responses not showing any tendency when sacrificial layer was not completely removed. We can see the residue on the resonator distorted the RF response worse than etch hole offset variation did.

3. 결 론

we present the effect on a novel transmission line filter response by the etch hole position on the suspended ground and the residue on the resonator under ground plane. We simulated filter responses to reflect the real value of the changed etch hole offset. The measurements are more similar to the new simulation than the previous one. Return loss graph is distorted compared with that of a filter without residue. By comparison of simulation and measurements the residue on the resonator distorted the RF response worse than etch hole offset variation did.

[참 고 문 헌]

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