微小化共面波導濾波器之設計、模擬與製作

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摘要

本文研究目的是探討微小化共面波導濾波器設計、模擬、製作與其量測特性，濾波器設計是使用 Meander 和 Interdigital 線路結構，其電路特性可等效為電感性與電容性元件，藉由串聯 Meander 和 Interdigital 線路實現慢波週期結構，Interdigital 結構設計的線寬為 5μm。完成製作的微小化共面波導濾波器屬於 5 階 Butterworth 低通濾波器，截止頻率為 4 GHz，其面積為 2×2.3 mm^2，與傳統步階阻抗濾波器比較可以減少 98 %的線路面積。

此外，本文使用 Sonnet 模擬微小化濾波器的散射參數，驗證濾波器的特性是否符合要求，使用 Thick Metal model 的金屬型式探討金屬厚度對於微小化濾波器的特性影響。濾波器的製作是利用微電鍍製程，完成製作的濾波器金屬厚度為 2~20μm，針對不同金屬厚度的濾波器模擬與量測結果比較，可知 Thick Metal model 的模擬與量測結果是相符合的，低通濾波器的截止頻率會隨著金屬厚度增加而往高頻偏移，而且調整 Meander 結構尺寸可以改變截止頻率，頻率改變範圍為 3~8 GHz，另一方面，藉由串聯此共面波導低通濾波器，可以增加止帶區的訊號衰減率。

Design, Simulation and Fabrication of Miniaturized RF-MEMS Filter

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Abstract

A compact-size coplanar waveguide (CPW) lowpass filter is designed, simulated, fabricated and measured. The purpose of this thesis is to investigate the performance of miniaturized CPW lowpass filter which is a fifth-order semi-lumped uniplanar Butterworth filter. Our design utilizes transmission line lumped elements consisting of interdigital capacitors and meander line inductors. These filters with different metal thickness (up to 20μm) are successfully fabricated by surface micromaching and copper electroplating technologies. The miniaturized CPW lowpass filter has a rather small circuit size operating at 4 GHz. This circuit area with 2×2.3 mm^2 is reduced by 98% when compared with conventional stepped-impedance filter (24.6×11.6 mm^2)

Besides, Sonnet software which has lossless and thick metal model conductor is used for investigating the performance of miniaturized lowpass filter with different metal thickness. Good agreement has been found between the simulation and experimental results. The experimental results show that the cutoff frequency of lowpass filter can be adjusted by varying the meander length and the metal thickness. By periodically cascading this lowpass structure, we can improve the characteristics in the stopband.