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Thick Film Planar Filter Simulation

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Annotation:
This paper deals with thick film planar microstrip edge coupled frequency filter design and realization, where the third order, chebyshev based design is considered. The realization then considers various apllication material and substrate thickness and the properties of the resulting structure are investigated.

INTRODUCTION

The planar thick film filters are important devices in modern electronic technology. We can divide them into categories according to the frequency band they are intended for. They are used in various applications including industry, military or transportation. The thick film technology is a cheap way to create the applications for wide range of frequencies. Some new thick film materials allow to realize structures whose properties are approach the properties of thin films.

The aim of the work presented in this paper is the design and simulation of the thick film microwave edge-coupled technology filter for the C-band. This can be used in many applications, as for example in satellite communication devices, weather radar technology etc.

MOTIVATION

Filter properties are strongly dependent on the designed topology, but also on the structure of the material. The aim is to achieve a solution of the filter structure to achieve a stable and reproducible parameters.

The various materials used as conductor have different properties and their choice can influence the overall behavior and characteristics of the system. Therefore, it is desirable to predict the behavior of each single combination of materials. The suitable way is the simulation. In this case, the simulation system Ansoft Designer was chosen. The scope of this paper is to determine the impact of used material on thick film edge coupled planar filter properties..

DESIGN

For the simulation, the edge coupled planar filter shown on Fig.1 was chosed and designed with ANSYS software. It is the filter of third order, the microstrip edge coupled filter where the Chebyshev approximation was used. The center frequency of the filter is 6 GHz (C-band), while the bandwidth is considered 0.2 GHz.The filter is considered with the distributed parameters, with the wavelength comparable with the filter structure dimensions.

The design is performed on the corundum substrate (Al2O3) with dielectric constant 9.8, when more paste materials are considered as the conductors. The simulations will be performed for these materials and their influence on the frequency characteristics will be studied. In addition, also the influence of the substrate thickness will be examinated for single selected conductor material, to examine the influence of this parameter too. The layout of the filter is on Fig.1.

Fig. 1: The layout of the filter design

RESULTS

On the Fig. 2 and Fig. 3 are listed results for various material of conductors of the planar filter. It four materials were considered, listed in Table 1. The S11 parameters are displayed on Fig. 2, while results for S12 parameters are on Fig.3. The substrate thickness is 635 µm.

Tab. 1: List of considered conductor materials

Conductive material	*Square resistivity*
Au	1 mΩ/□
Pt-Au	20 mΩ/□
Pd-Ag	10 mΩ/□
Ni	50 mΩ/□

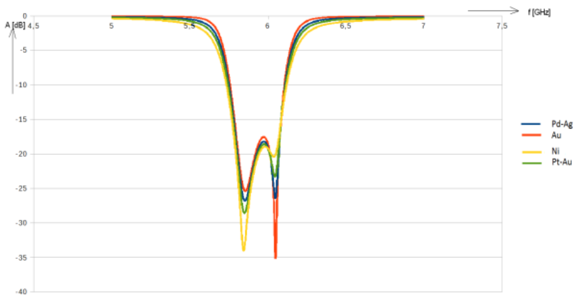

Fig. 2: The S11 Parameter for various conductive material.

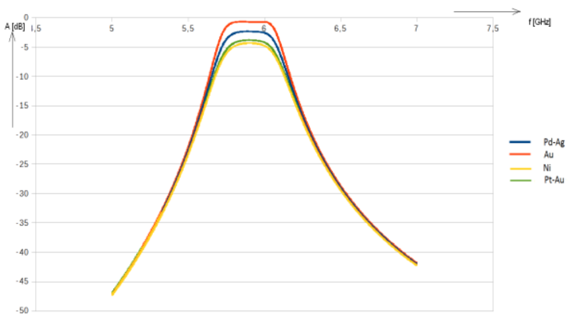

Fig. 3: The S12 Parameter for various conductive material.

The gold conductor paste was considered on the next experiment, while the substrate thickness varied in the values 400, 500, 600, 700, 800 a 900 µm. The S11parameter for various thickness value is displayed on Fig. 4, while the S12 parameter is on Fig. 5.

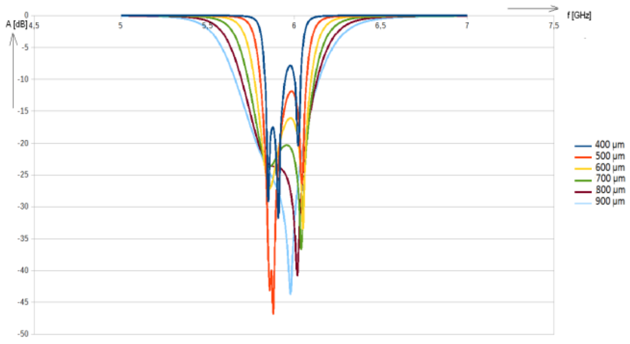

Fig. 4: The S11 parameter for various substrate thickness

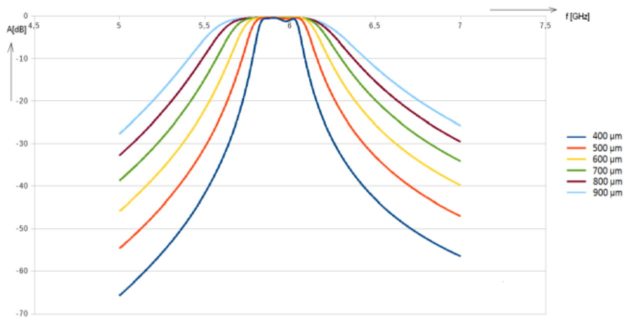

Fig. 5: The S12 parameter for various substrate thickness

CONCLUSION

From Fig. 2 and Fig. 3 is obvious the impact of various materials on the S11 and S12 parameter. The higher attenuation on S12 is caused by higher serial resistance caused by higher square resistivity.
The rising thickness of base material causes the pass band widening, what is obvious from Fig. 4 and from Fig. 5. The maximum of S12 parameter does not vary. Unlike that, the value of minims of S11 varies between 20 and 40 dB.

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