Study on optimization design of milli-meter wave devices and transmission lines

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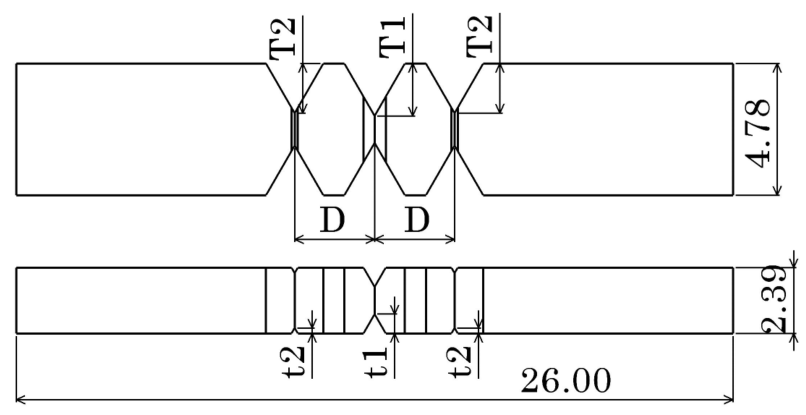
Prototype of 3D-Printed Millimeter-wave Dielectric Filled Waveguide Filter

Motivation

5G is now in operation, and access points are beginning to become faster. In the future, it is expected that high-speed communication of 100 GHz or more, known as Beyond 5G, will be realized. On the other hand, in recent years, 3D printers have also become more precise year by year, and printing at 10 µm pitch is now possible. Therefore, the purpose of this study is to inexpensively manufacture millimeter-wave components using 3D printers.

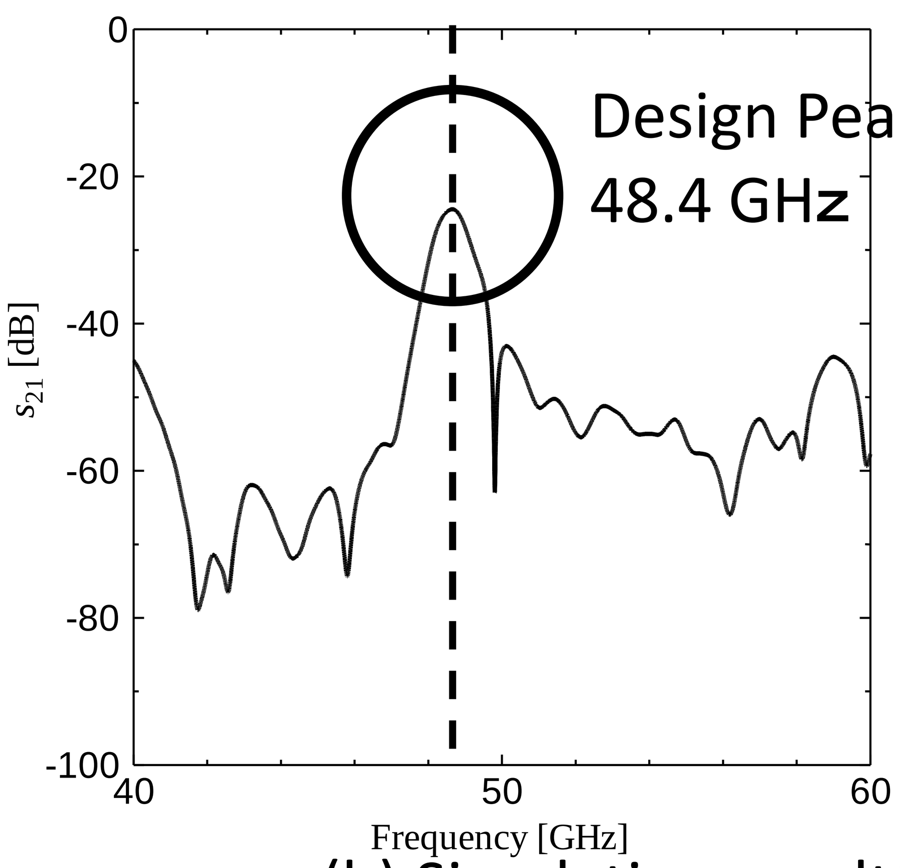
In a previous study, we reported that after prototyping a millimeter-wave waveguide filter using 3DP, electroless nickel plating was applied to reproduce fine millimeter-wave components at low cost. It is also possible to prototype a dielectric-filled waveguide by plating a 3D printer product, and it is expected that the degree of freedom in prototyping will be much higher than that of a hollow waveguide. In this study, a bandpass filter (BPF) using a dielectric-filled waveguide is prototyped and measured.

Design



D=2.9 mm
T_1=1.9 mm
T_2=1.8 mm
t_1=0.7 mm
t_2=0.2 mm

(a) Design parameters



(b) Simulation result(FDTD)

Fig. 1 Design reslts

Prototype

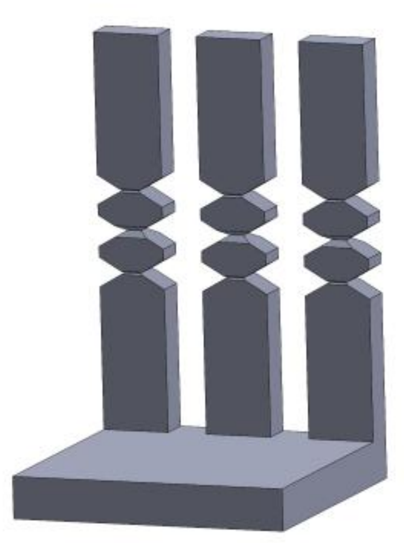
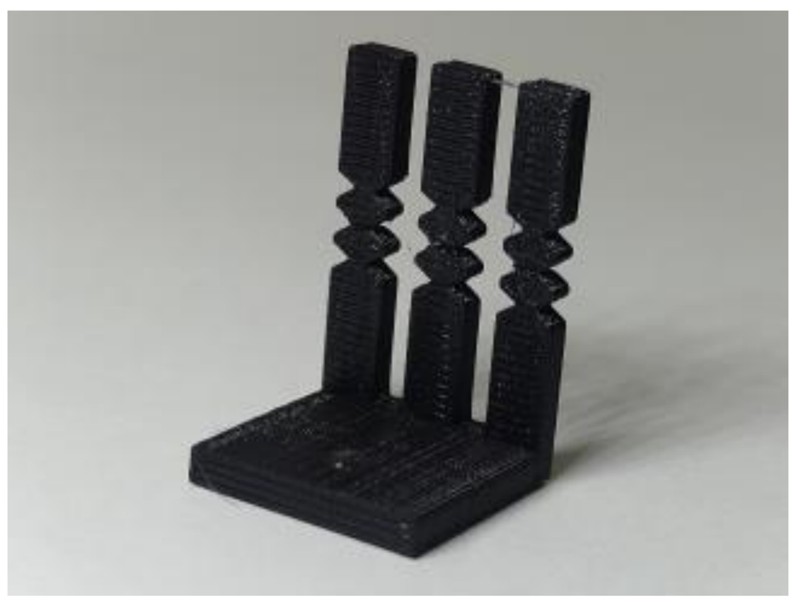


Fig. 2 CAD image

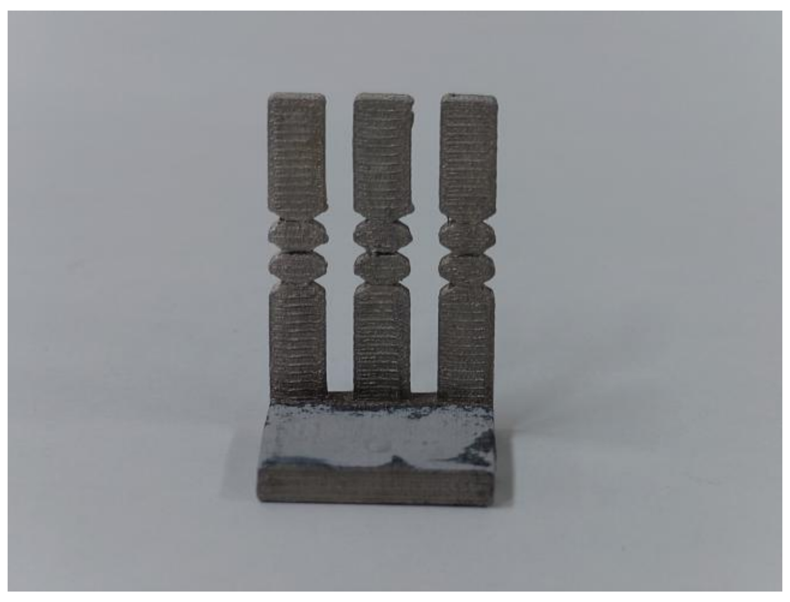
3D printing
3D printer: ATOM MAESTRO
Filament: PLA+

Prototype

Electroless nickel plating
Plating time: 2 hours
Catalyst: Palladium chloride solution (soaked for 1 hour)



(a) 3D printing



(b) After plating

(c) Coating

Fig. 3 prototype results

Measurement

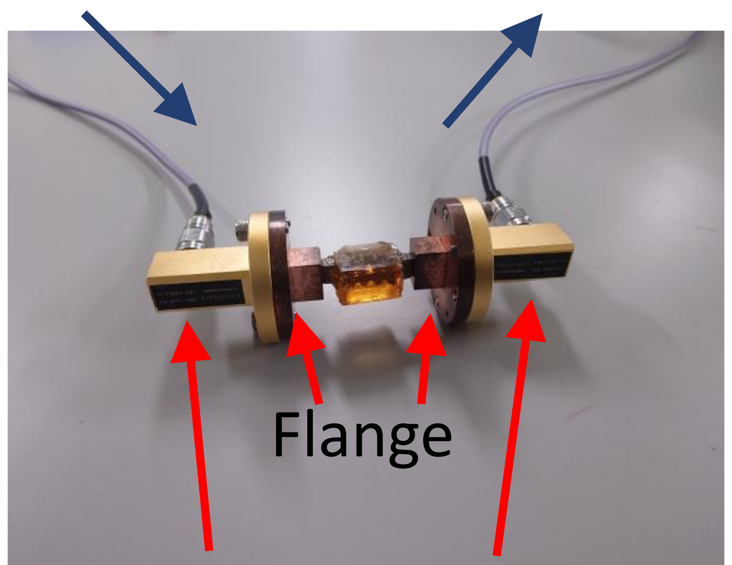
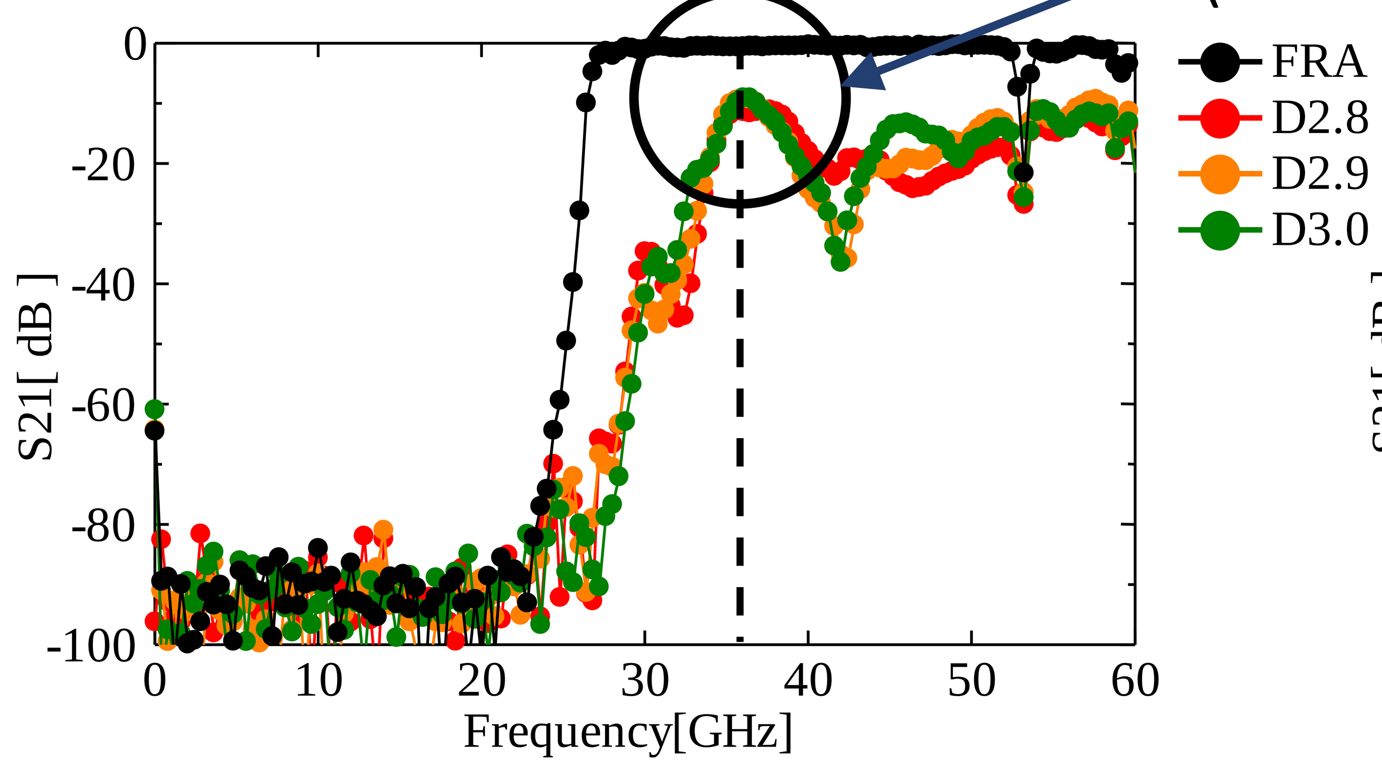


Fig. 4 Measurement configuration



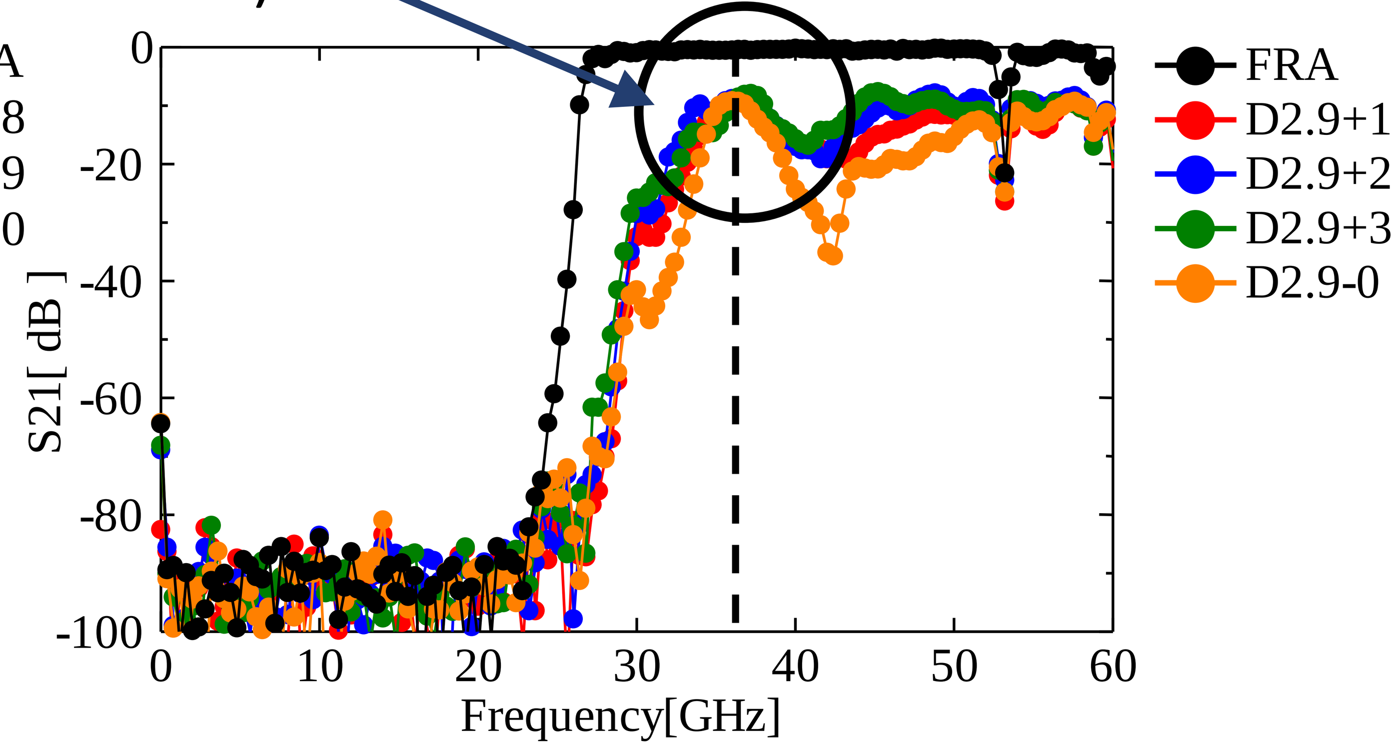


Fig. 5 Measured result of transmission coefficient s_{21}

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