

Comparative Study of Different Dielectric Substrates on Microstrip Patch Antenna for new generation (5G)

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Recent research has shown that choosing the right substrate for dielectric materials can enhance the antenna performance for the next generation of wireless communications. In this work, we present the results of the comparative studies on the performances of the microstrip antennas for the new generation (5G) based on specific characteristics of dielectric substrate. The main objective of this work is to choose composite material with the best dielectric properties to design antennas with the best characteristics. The results obtained are discussed and the performance comparison (gain, bandwidth, directivity and radiation pattern) of a rectangular patch antenna is established in order to show the effect of certain parameters of the antenna on its characteristics.

Preparation and properties

The properties of different substrate materials

- ❖ **ROGERS RT/Duroid 6002** having a thickness(h) of 0.762mm, a dielectric permittivity of 2.94 and loss tangent of 0.0012
- ❖ **RO4003** which has a dielectric constant of 3.4 and loss tangent of 0.02 and thickness $h= 1.2$ mm.
- ❖ **FR-4 epoxy** with thickness $h=1.6$ mm, relative permittivity $\epsilon_r=4.4$ and loss tangent of 0.025.

Dielectric Structure

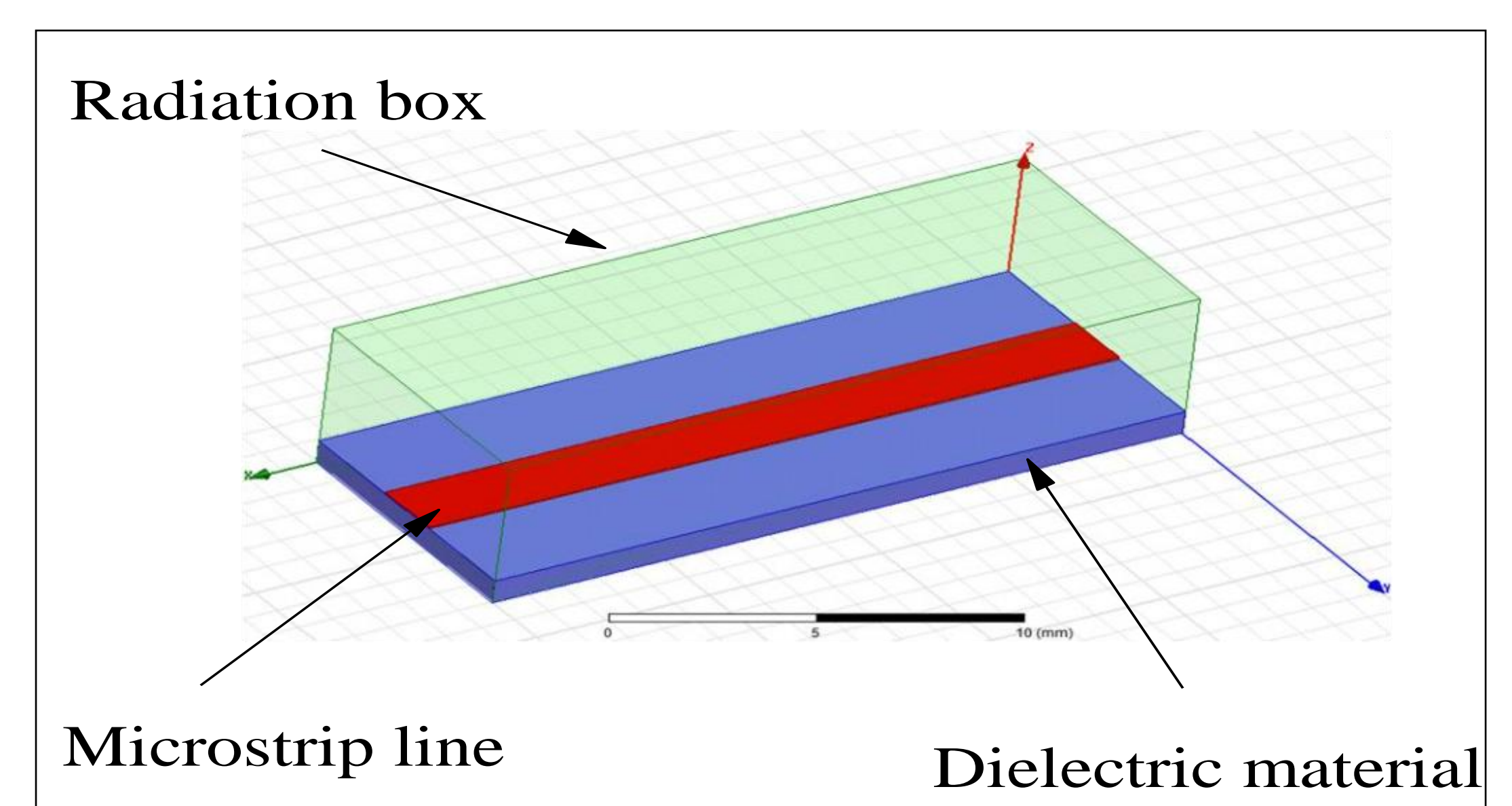


Fig. 1: Dielectric substrate design

Simulation results

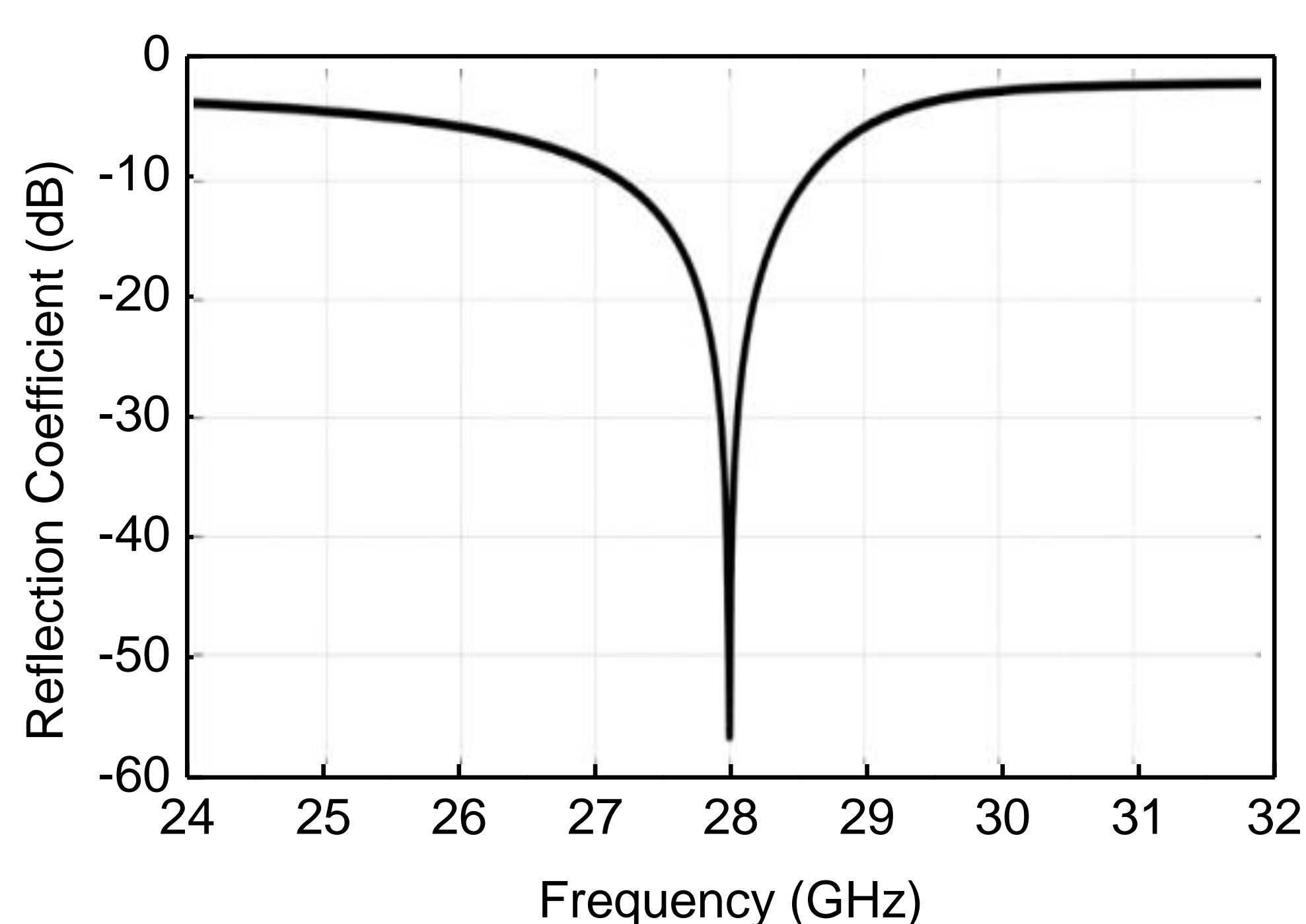


Fig. 2.: The simulation results of the reflection coefficient of an antenna mounted on a Roger RT Duroid 6002 substrate.

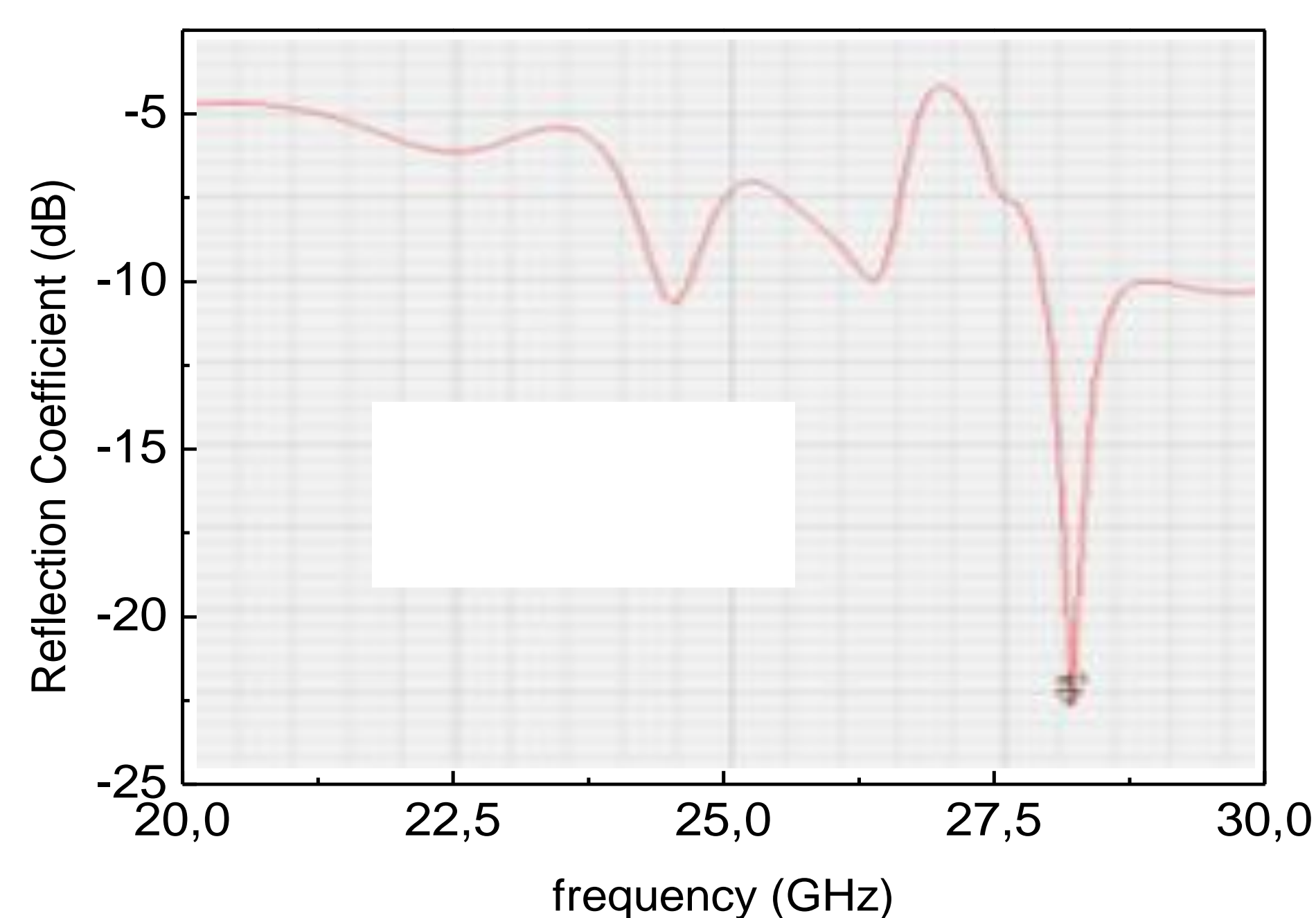


Fig. 3: The simulation results of the reflection coefficient of an antenna mounted on a RO4003 substrate.

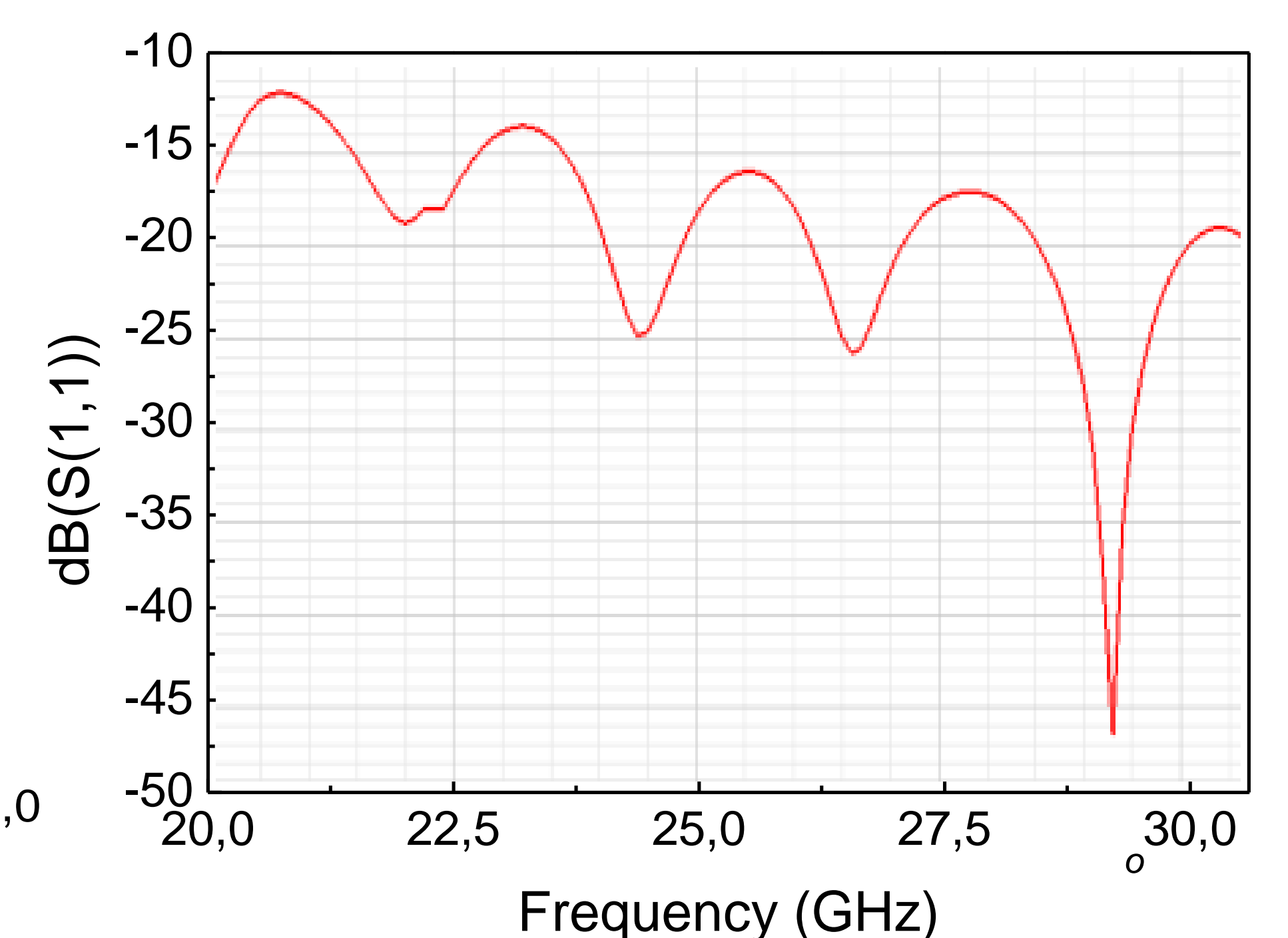


Fig. 4: The simulation results of the reflection coefficient of an antenna mounted on a dielectric substrate named FR-4 epoxy

Table 1: Results of different substrates for microstrip patch antenna design

Parameters	ROGERS RT/Duroid	RO4003	FR-4 epoxy
Dielectric constant	2,94	3,4	4,4
Loss tangent	0,0012	0,02	0,025
S11 (dB)	- 57,97	- 46,04	- 23
Gain (dB)	7,6	2,54	4,2
Directivity (dB)	7,67	6,36	2,39

The table gives values for different parameters for all the considered substrates, indicating the effect of the performance of the substrates at the antennas.

Conclusion

The three different substrates FR4 epoxy, RO4003, and ROGERS RT/Duroid 6002, which are used for the simulation of microstrip patch antennas, were studied. The good results are found in the case of the ROGERS RT/Duroid 6002 because it gives the bandwidth is directly proportional to the dimensions of the antenna. While, the ROGERS RT / Duroid 6002 has the lowest dielectric constant among the three substrates, which also increases the bandwidth because the bandwidth is inversely proportional to the dielectric constant or the permittivity. The simulation with the substrate ROGERS RT/Duroid 6002 gives higher gain and directivity compared to other substrates

References

- [1] W. Abbas Awanet et al. International Conference on Microwaves for Intelligent Mobility (ICMIM), Nagoya, 2017, pp. 21-24
- [2] S. Rehan Haneef et al. Int. J. Electron. Commun. 65 (2019) 557-563
- [3] R. Abhusan Panda . J. Emerg. Technol. Innov. Res. 4 (2017) 9483-9887.