Microwave Absorption Properties of Surfactant Treated Carbon Nanotubes in Epoxy Composites in 1 - 40 GHz

Daneisha Blair, Dr. Guang-Lin Zhao*
Physics Department
Southern University and A&M College
Baton Rouge

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Louisiana Alliance for Simulation-Guided Materials Applications

Southern University and Agricultural & Mechanical College

Outline

- **Introduction**

  Microwave, Microwave Absorption, Carbon Nanotubes, Surfactant, Epoxy

- **Goal**

- **Method**

  The process to make composite samples

- **Result**

  Coaxial and Waveguide methods: reflection, transmission, and absorption ratios.

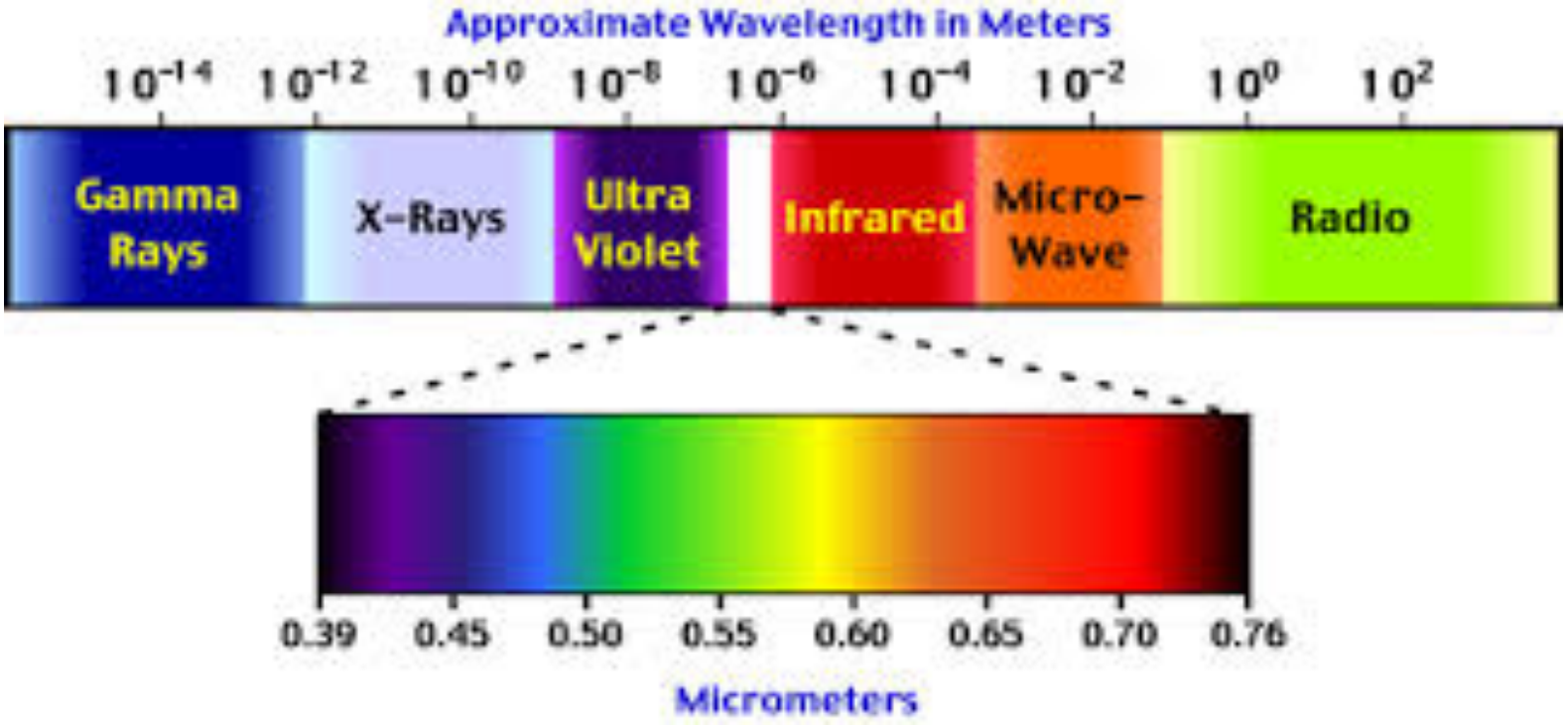
- **Conclusion**

- **Acknowledgment**

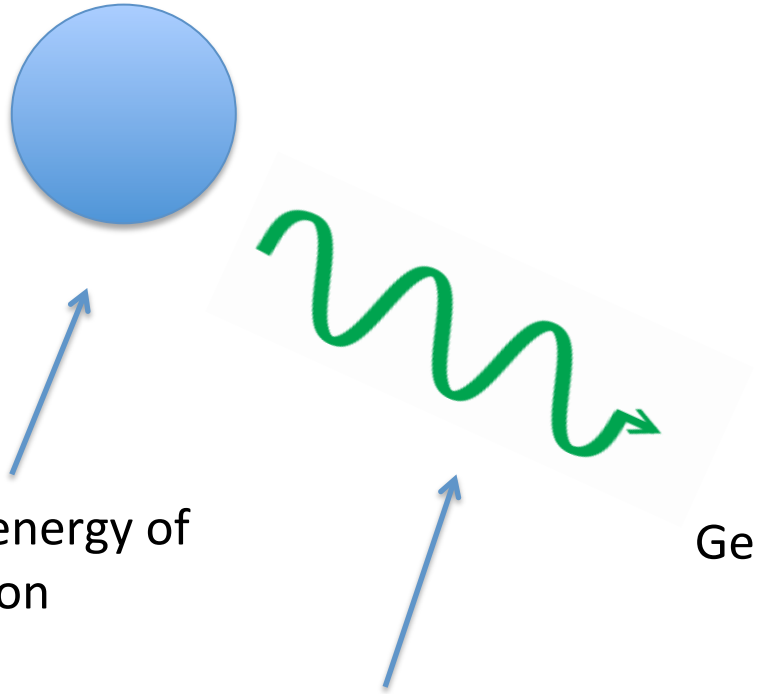
Introduction

What is Microwave?

Microwaves are electromagnetic waves in part of the electromagnetic spectrum.



How Electromagnetic Wave is formed?

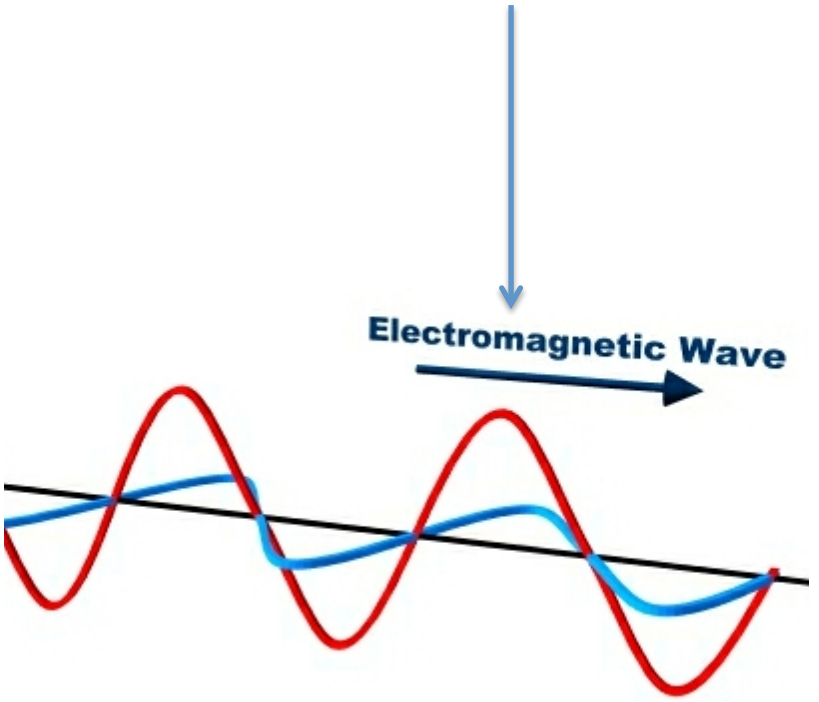


The energy of photon

Vibration created by electric charge in the photon

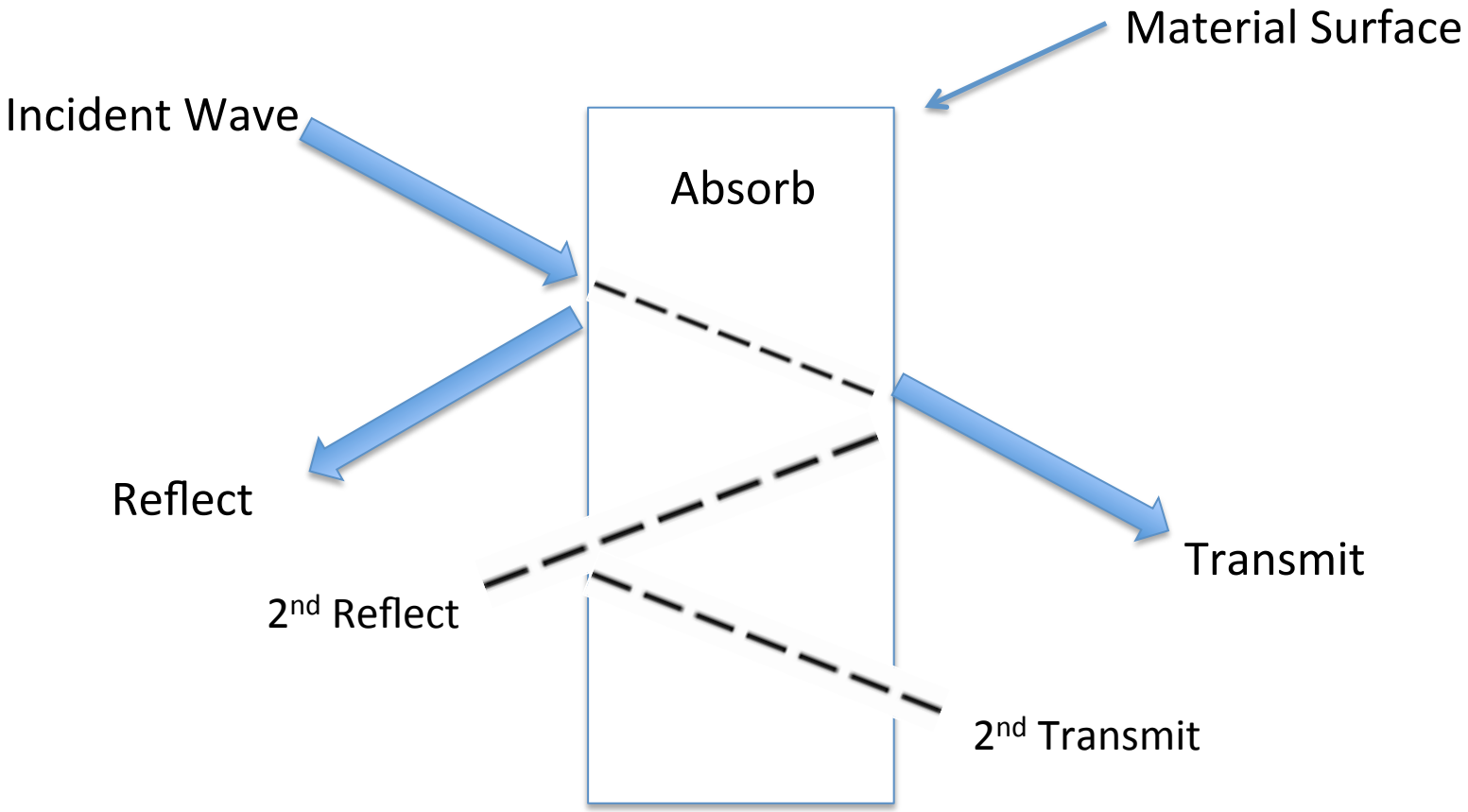
Generate

Electromagnetic Wave (EMW)



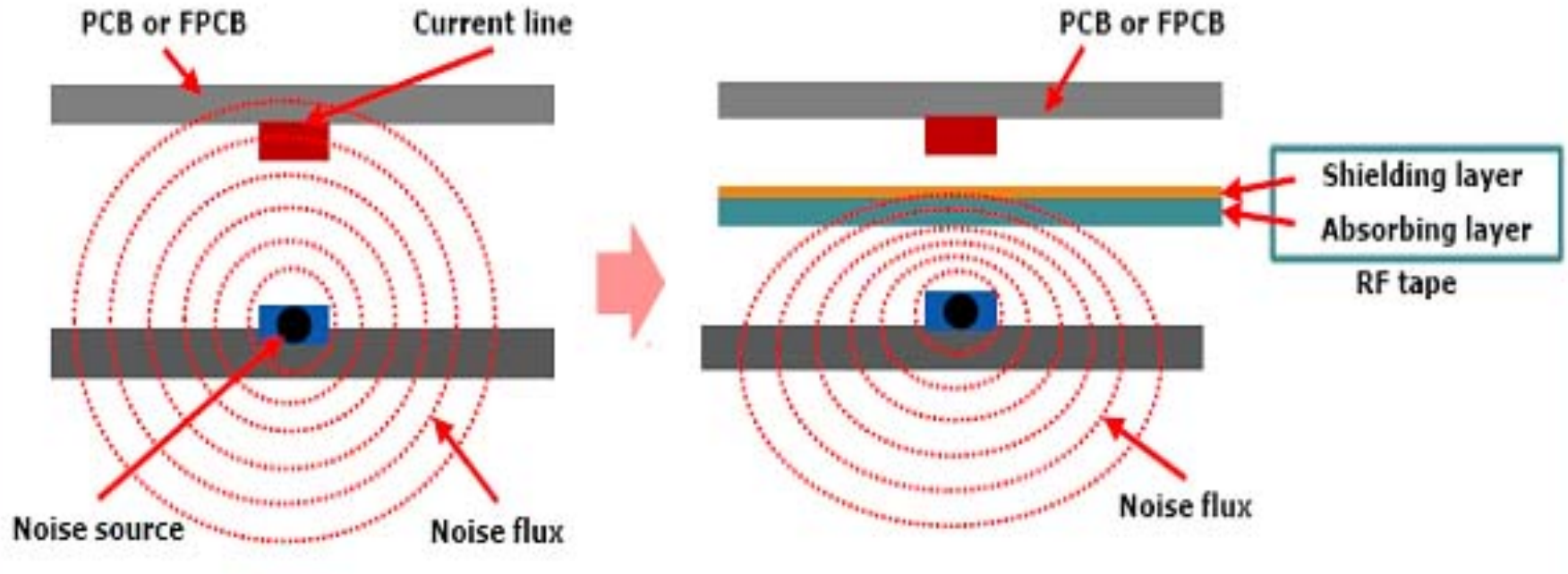
Electromagnetic (EM) energy

- the EM wave energy can be reflected, transmitted, and absorbed.

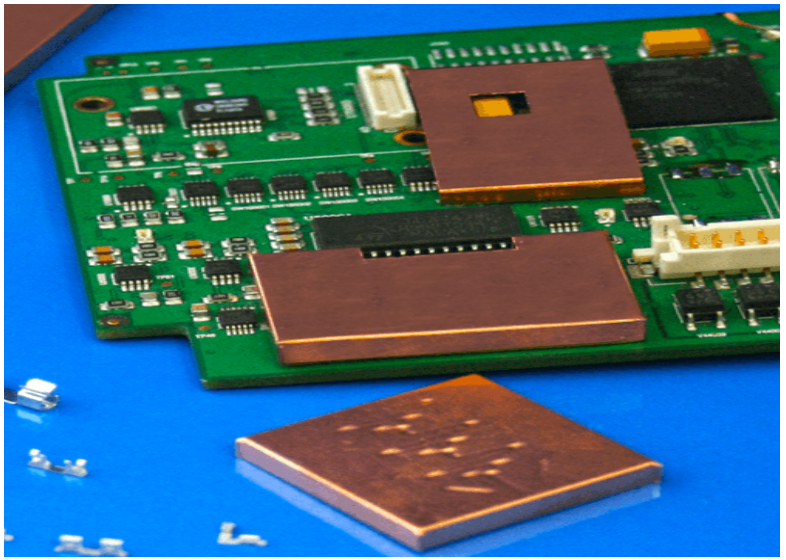


Microwave Absorption (MWA)

- MWA material show reflection, transmission, and absorption properties.

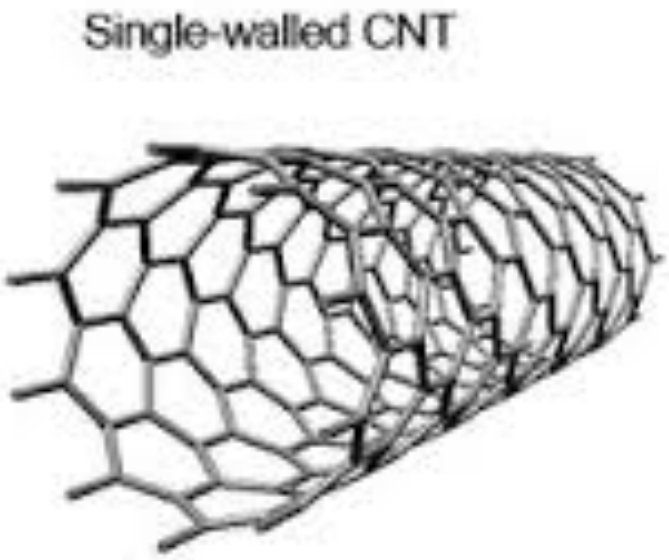


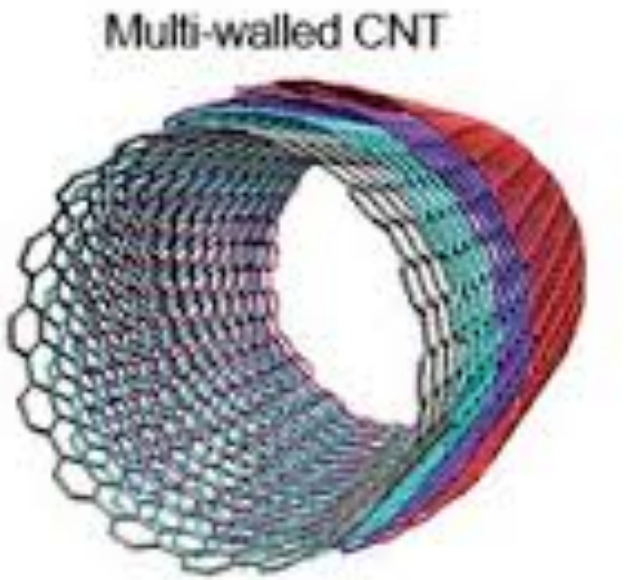
Applications that use MWA



Carbon Nanotube (CNT)

- CNTs emerged to know as a good MWA material because of its electrical and mechanical properties.

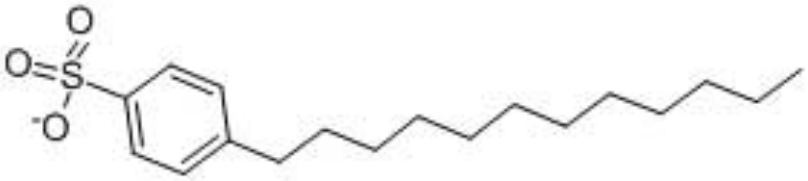




Surfactant & Epoxy

Surfactant

Sodium Dodecyl BenzeneSulphonate (SDBS)



$C_{18}H_{29}NaO_3S$

Molecular formula

Epoxy

Epoxy 11

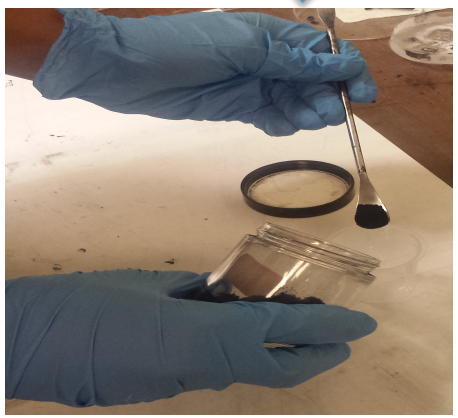
Epoxy 300

- **To investigate the 3wt%(weight percentage) Multi-Wall Carbon Nanotube (MWCNT) treated with different SDBS ratios to find the MWA results of reflection, transmission, and absorption ratio.**

Method

MWCNTs/SDBS-epoxy composites were fabricated by using mixture methods.

ultrasonic agitation



organic solvent

mechanical stirring

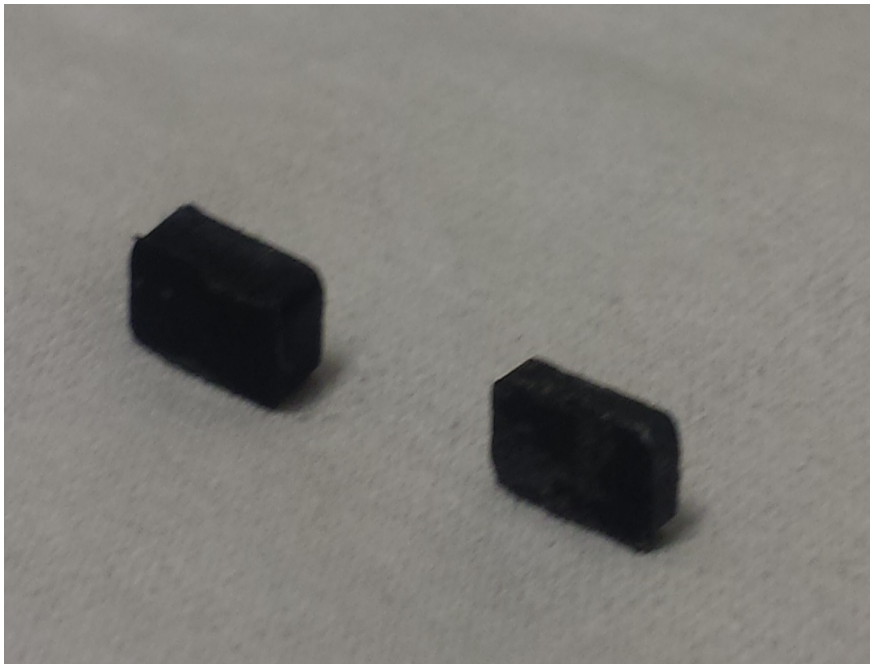
High temperature baking

Samples

Coaxial Sample

Frequency range from 1-26.5 GHz

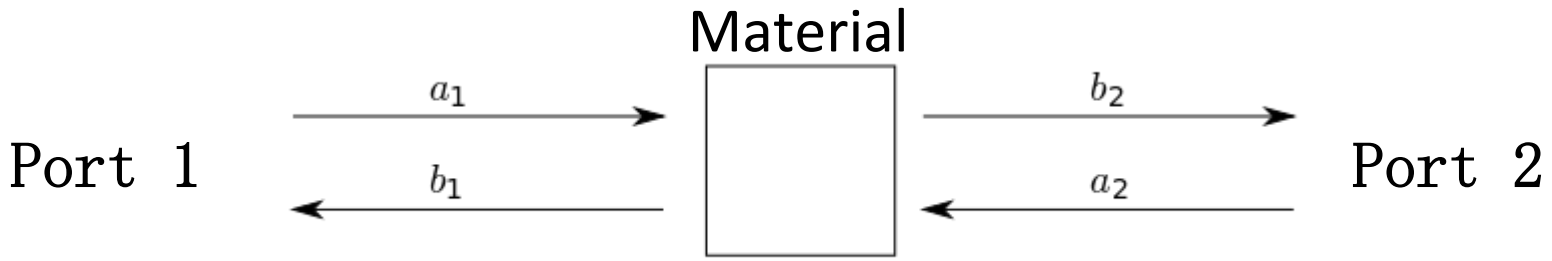
Waveguide samples



Frequency range from 26.5-40 GHz

Agilent Network Analyzer N5230c and Agilent 85071 measurement software were used for the measurements

Scattering Parameters



$$S_{11} = \frac{b_1}{a_1}, S_{21} = \frac{b_2}{a_1}, S_{12} = \frac{b_1}{a_2} and \quad S_{22} = \frac{b_2}{a_2}$$

S_{11} is the port 1 reflection coefficient

S_{12} is the transimissoin coefficient

S_{21} is the transimissoin coefficient

S_{22} is the port 2 reflection coefficient

$$RL = 10\log_{10}\left|\frac{1}{S_{11}^2}\right| = -20\log_{10}|S_{11}| \qquad dB$$

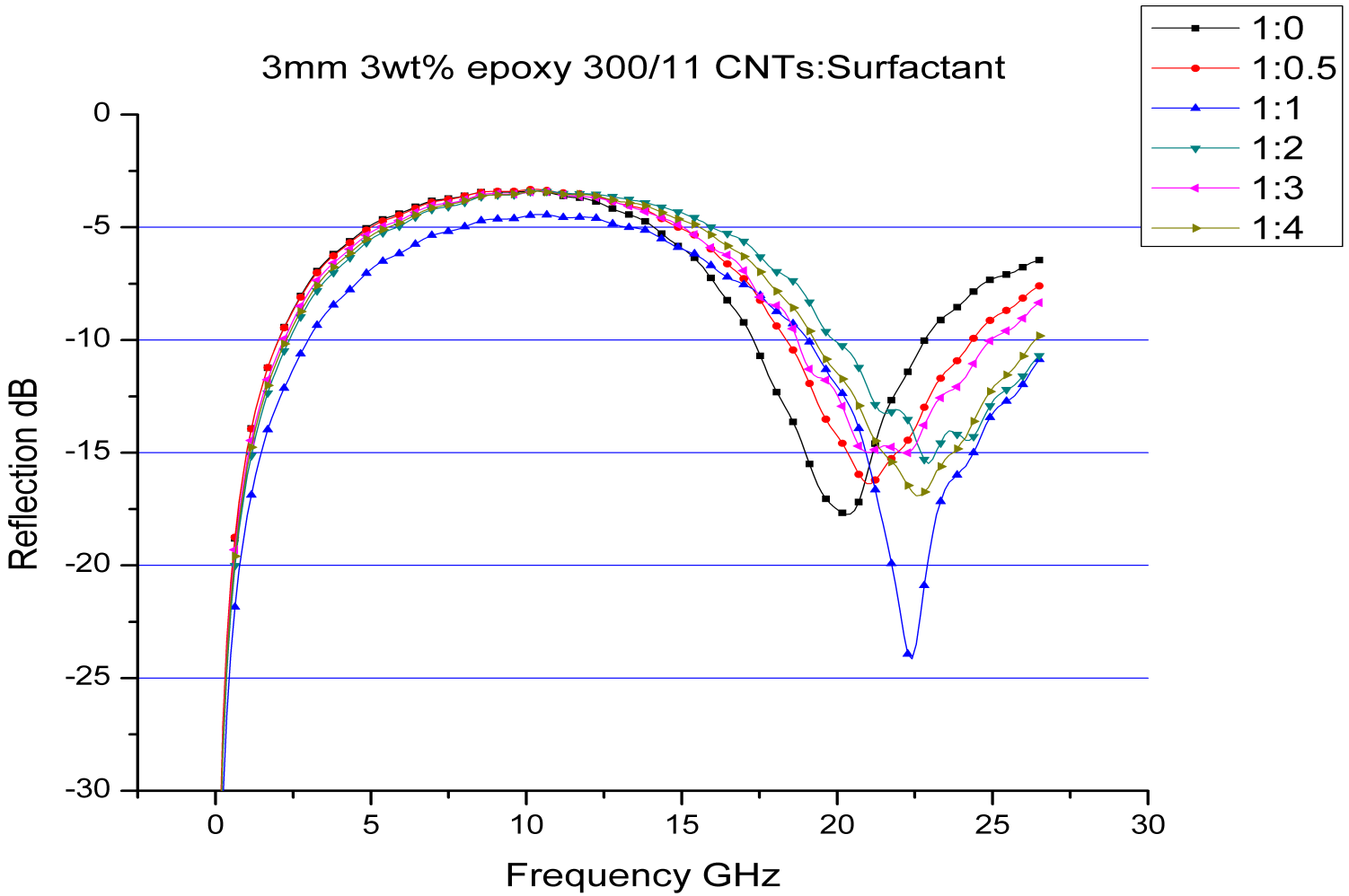
Bare in mind

dB	Percentage	dB	Percentage	dB	Percentage
-1dB	79.4%	-8dB	15.8%	-15dB	3.1%
-2dB	63.1%	-9dB	12.6%	-16dB	2.5%
-3dB	50.1%	-10dB	10%	-17dB	2%
-4dB	39.8%	-11dB	7.9%	-18dB	1.5%
-5dB	31.6%	-12dB	6.3%	-19dB	1.25%
-6dB	25.1%	-13dB	5%	-20dB	1%
-7dB	20%	-14dB	3.9%		

The diagram shows the percentage result of different dB values.

Result

Coaxial 3mm samples: Microwave Reflection loss



Figures 1 shows that the composites with different ratios of MWCNT/SDBS have different reflection loss properties.

Coaxial 2mm samples: Microwave Reflection loss

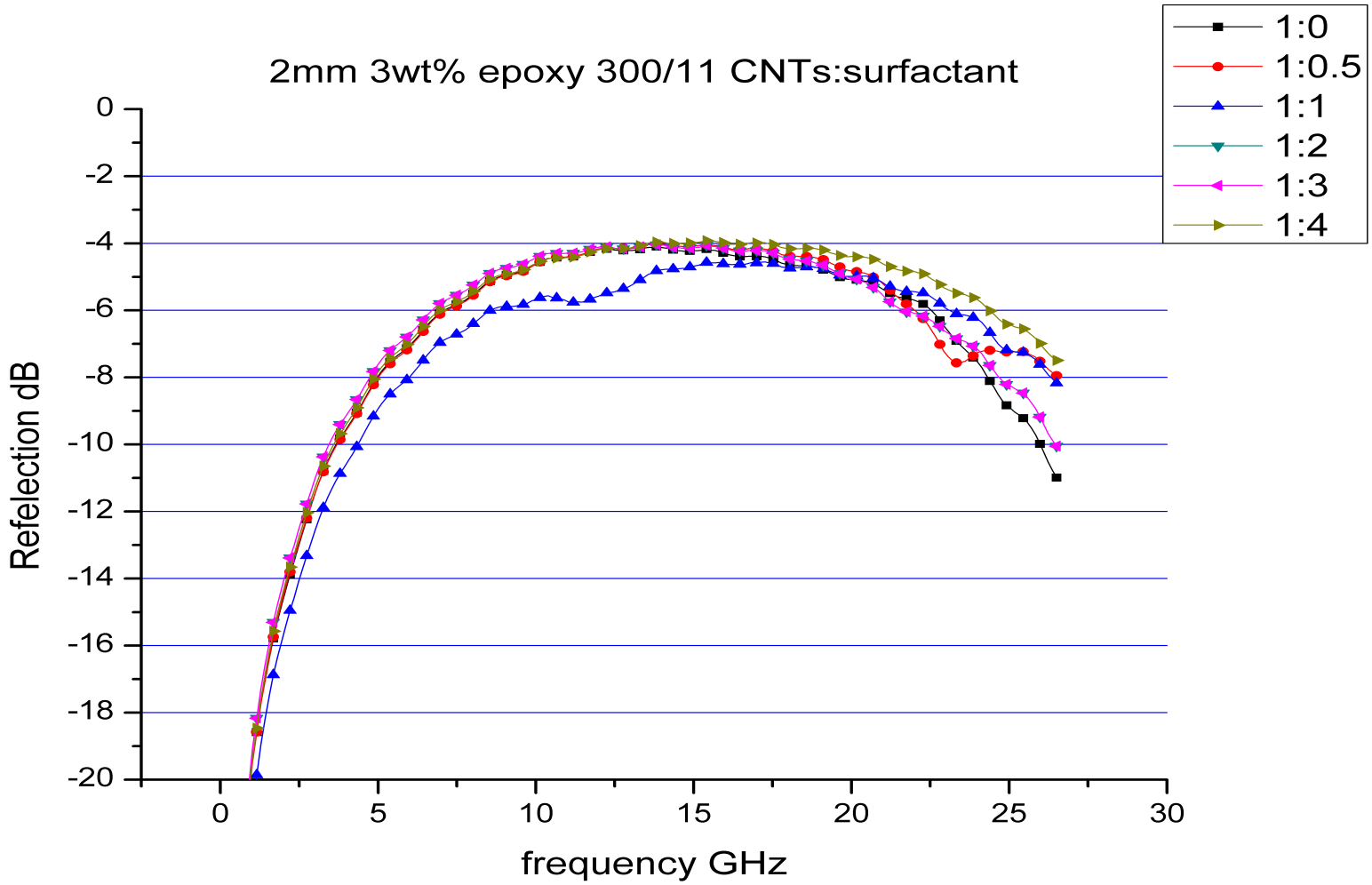
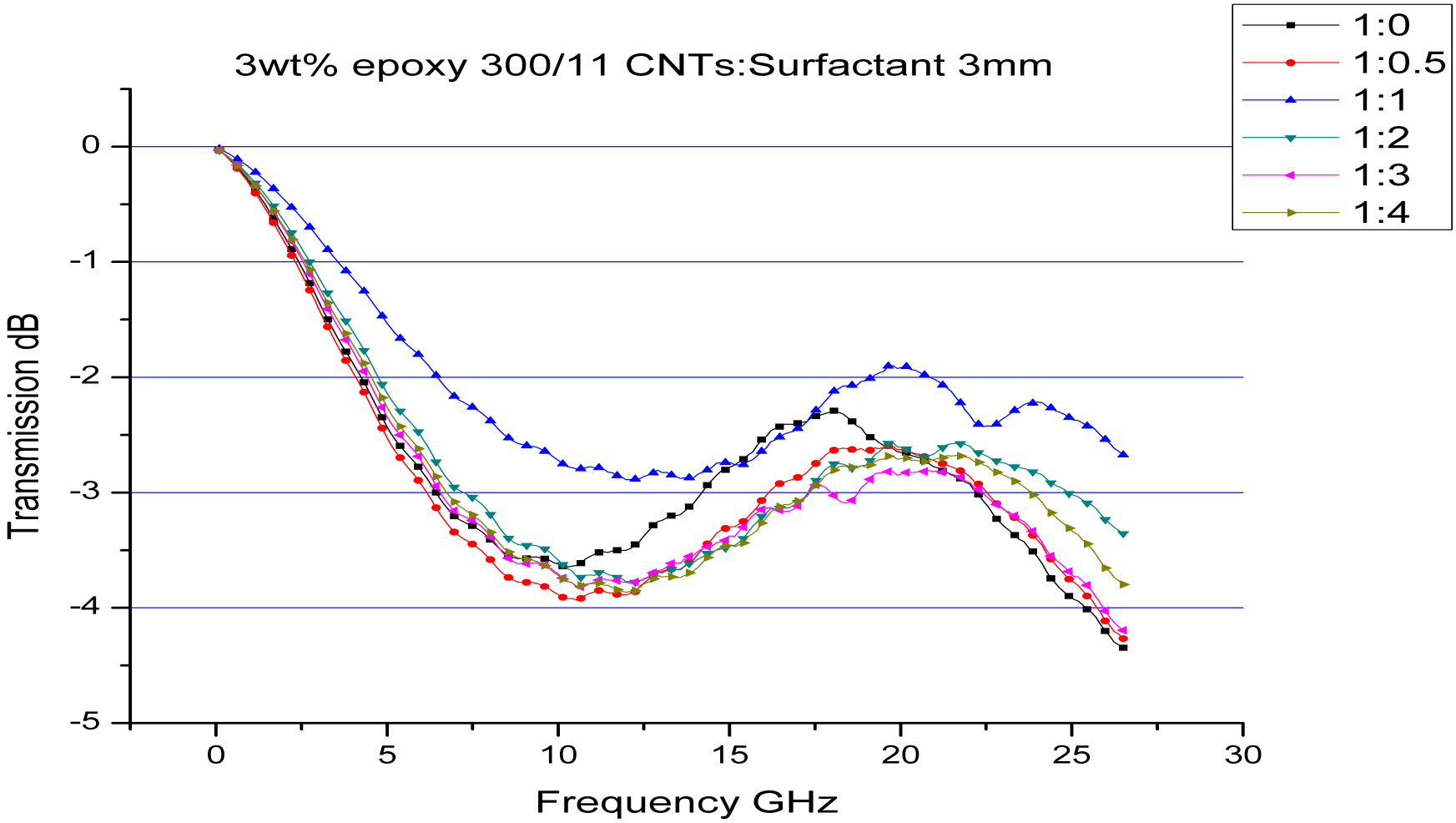


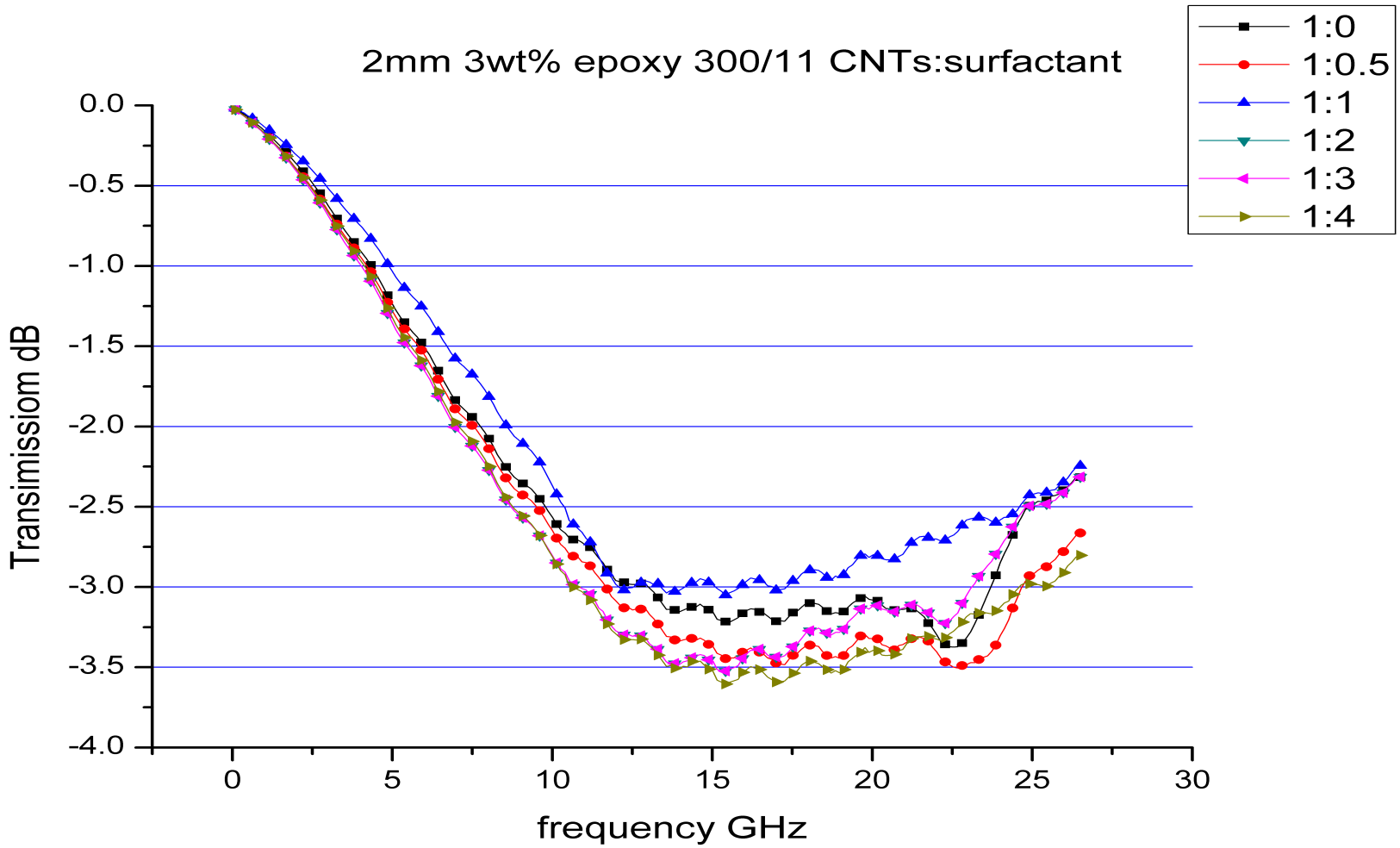
Figure 2 shows that the composites with different ratios of MWCNT/SDBS have different reflection loss properties

Coaxial 3mm samples: Microwave Transmission loss



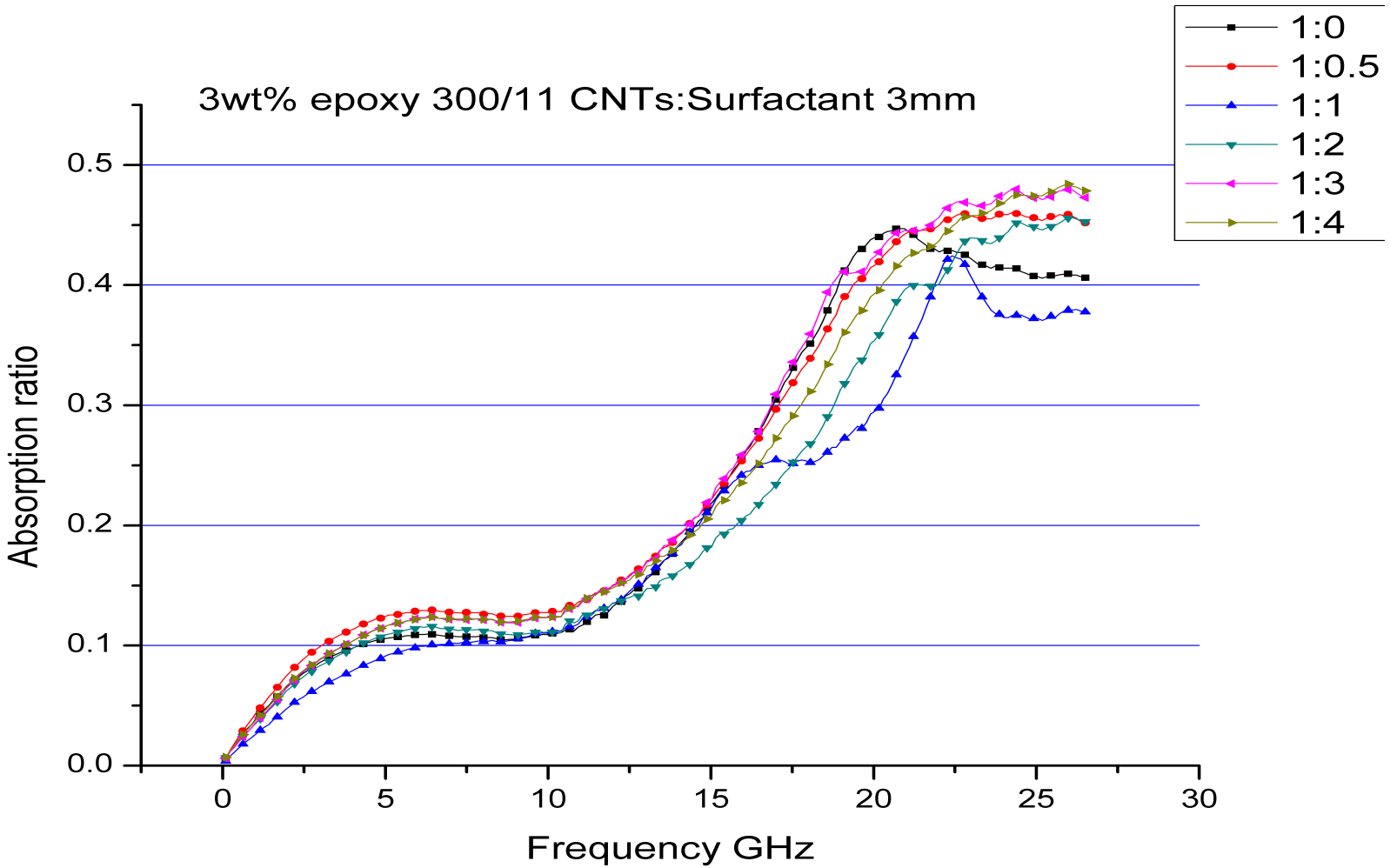
Figures 3 shows that the composites with different ratios of MWCNT/SDBS have transmission properties.

Coaxial 2mm samples: Microwave Transmission loss



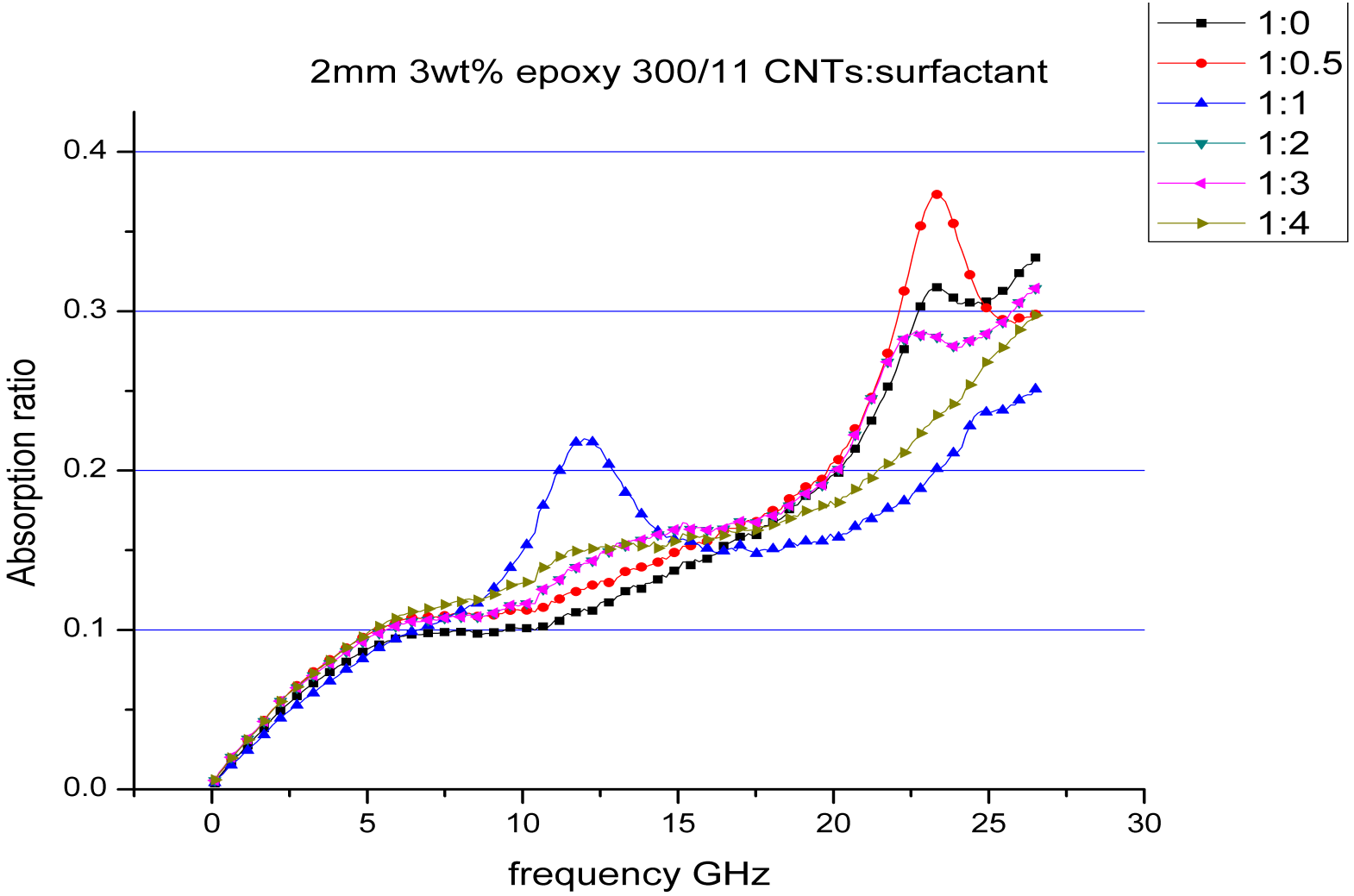
Figures 4 shows that the composites with different ratios of MWCNT/ SDBS have different transmission loss properties.

Coaxial 3mm samples: Microwave Absorption ratio



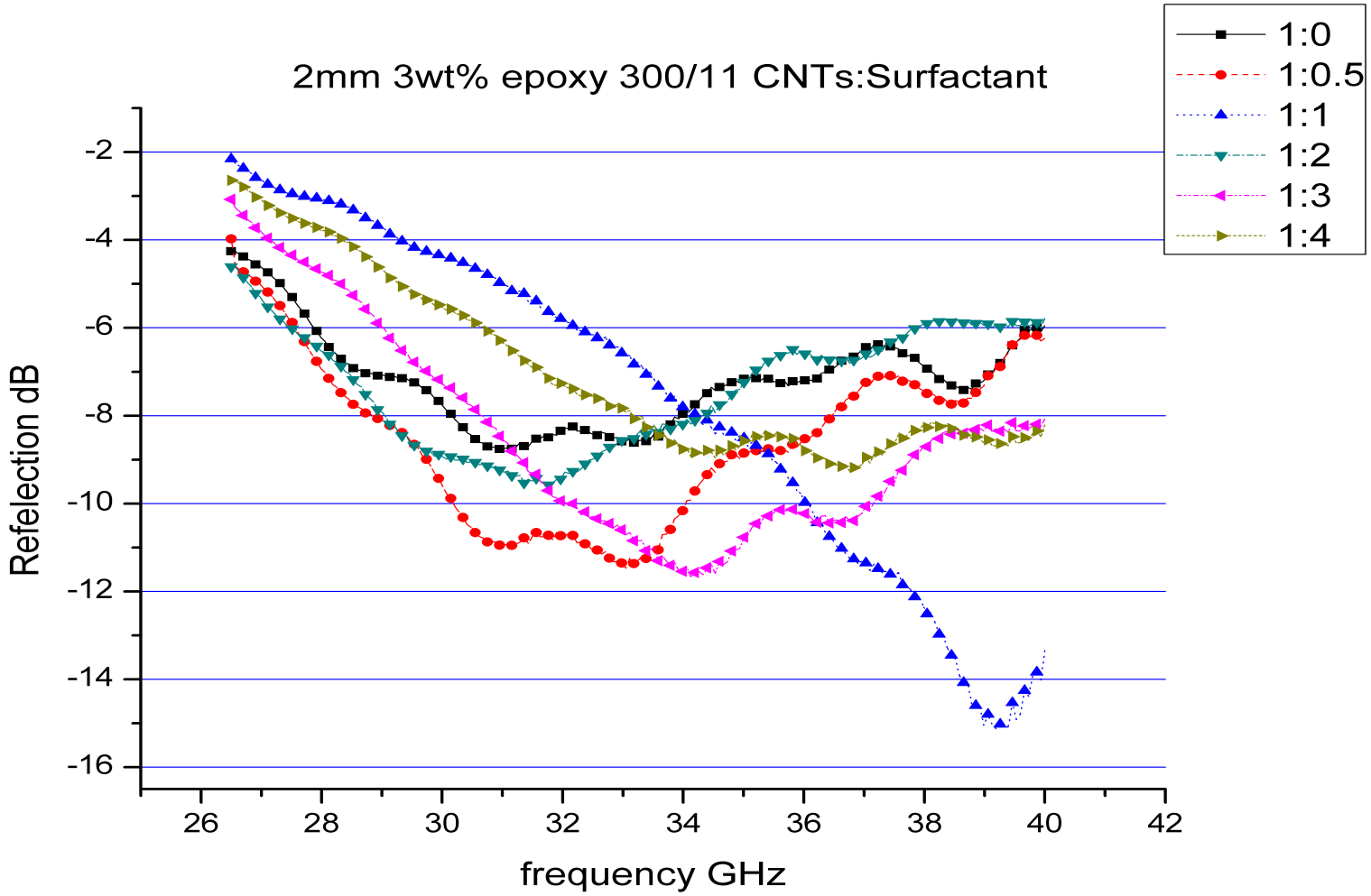
Figures 5 shows that the composites with different ratios of MWCNT/SDBS have different absorption ratios.

Coaxial 2mm samples: Microwave Absorption ratio



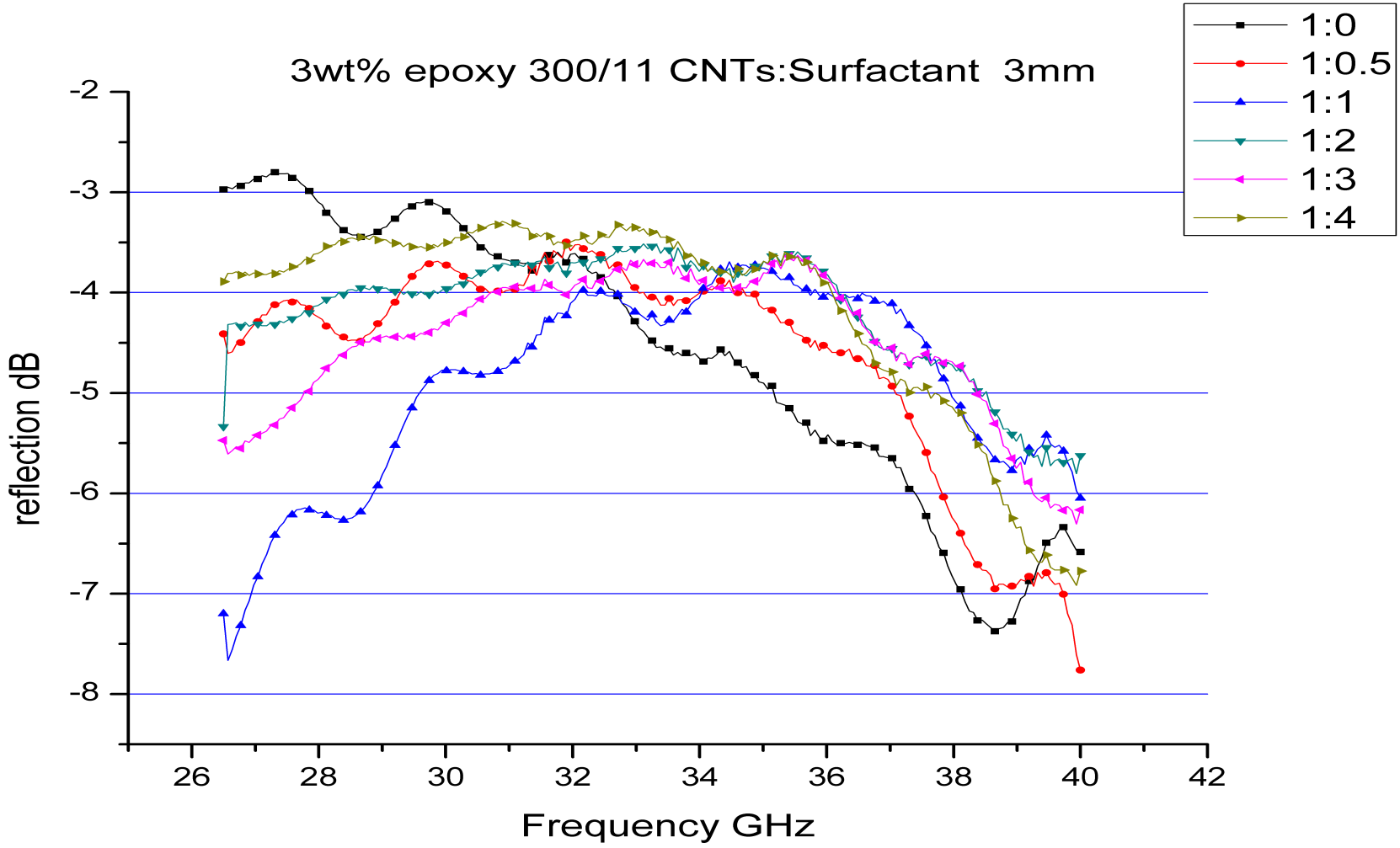
Figures 6 shows that the composites with different ratios of MWCNT/ SDBS have different absorption ratios.

Waveguide 2mm samples: Microwave Reflection loss



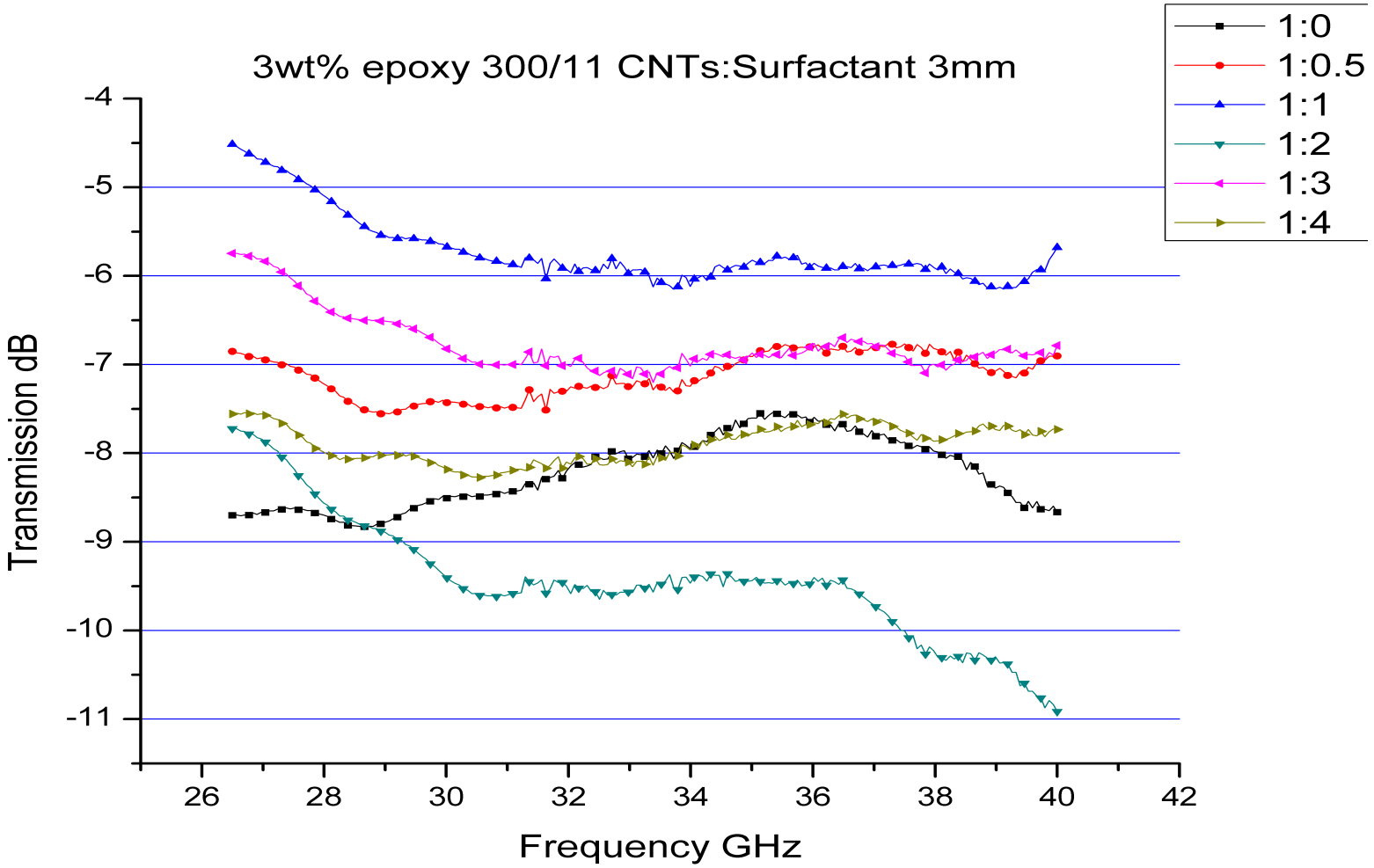
Figures 7 shows that the composites with different ratios of MWCNT/SDBS have different reflection loss properties.

Waveguide 3mm samples: Microwave Reflection loss



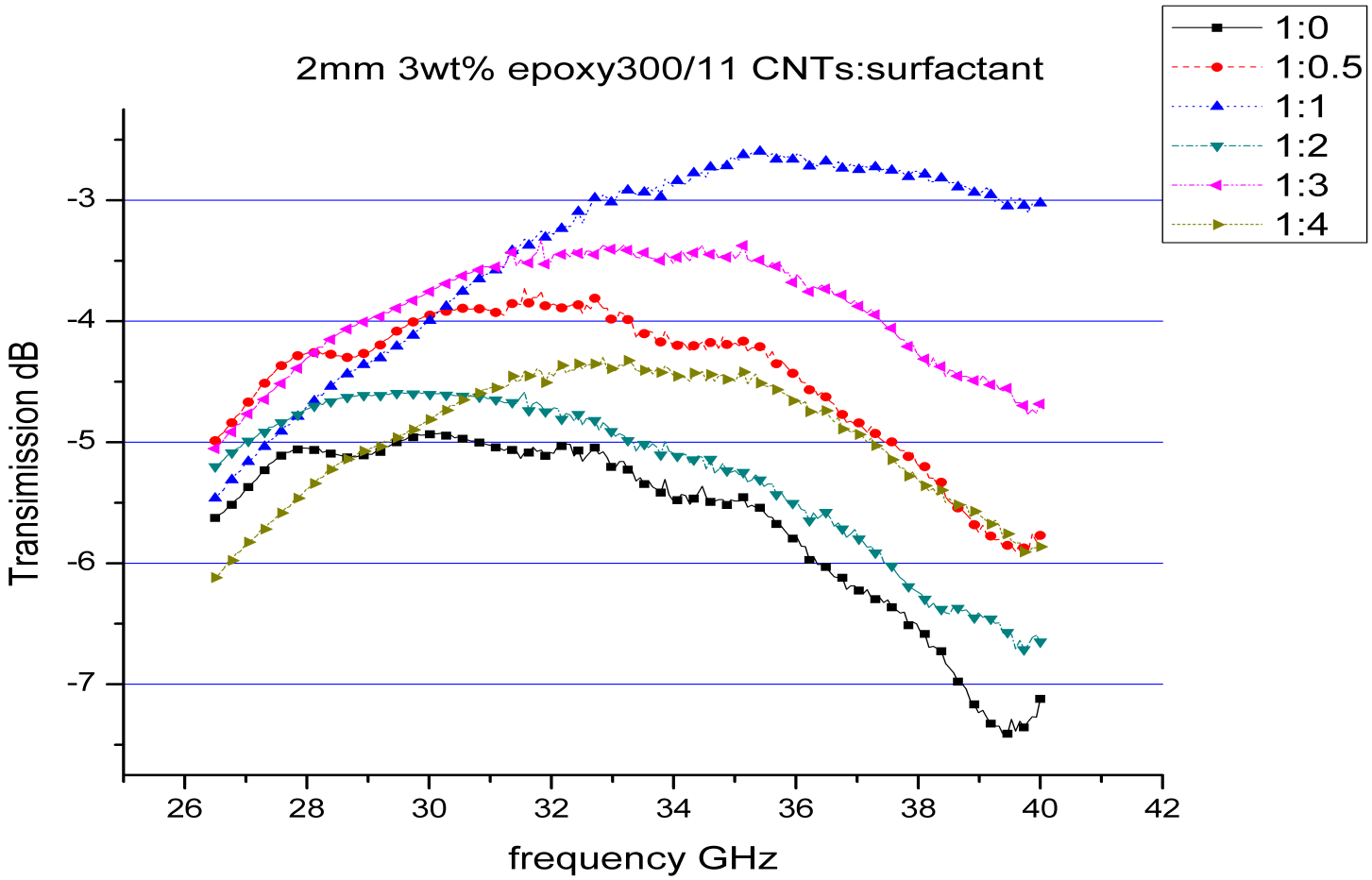
Figures 8 shows that the composites with different ratios of MWCNT/SDBS have different reflection loss properties.

Waveguide 3mm samples: Microwave Transmission loss



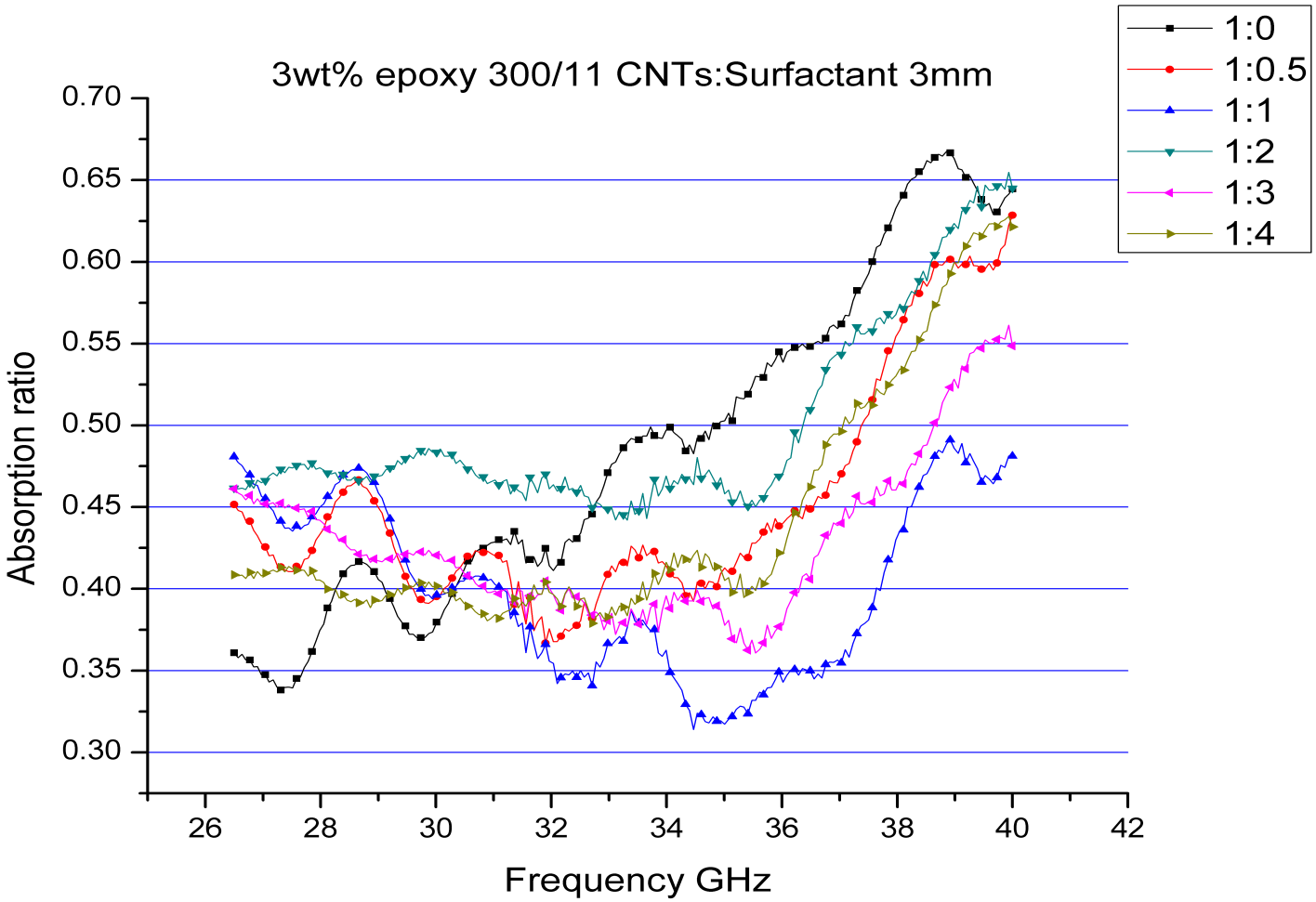
Figures 9 shows that the composites with different ratios of MWCNT/SDBS have different transmission loss properties.

Waveguide 2mm samples: Microwave Transmission loss



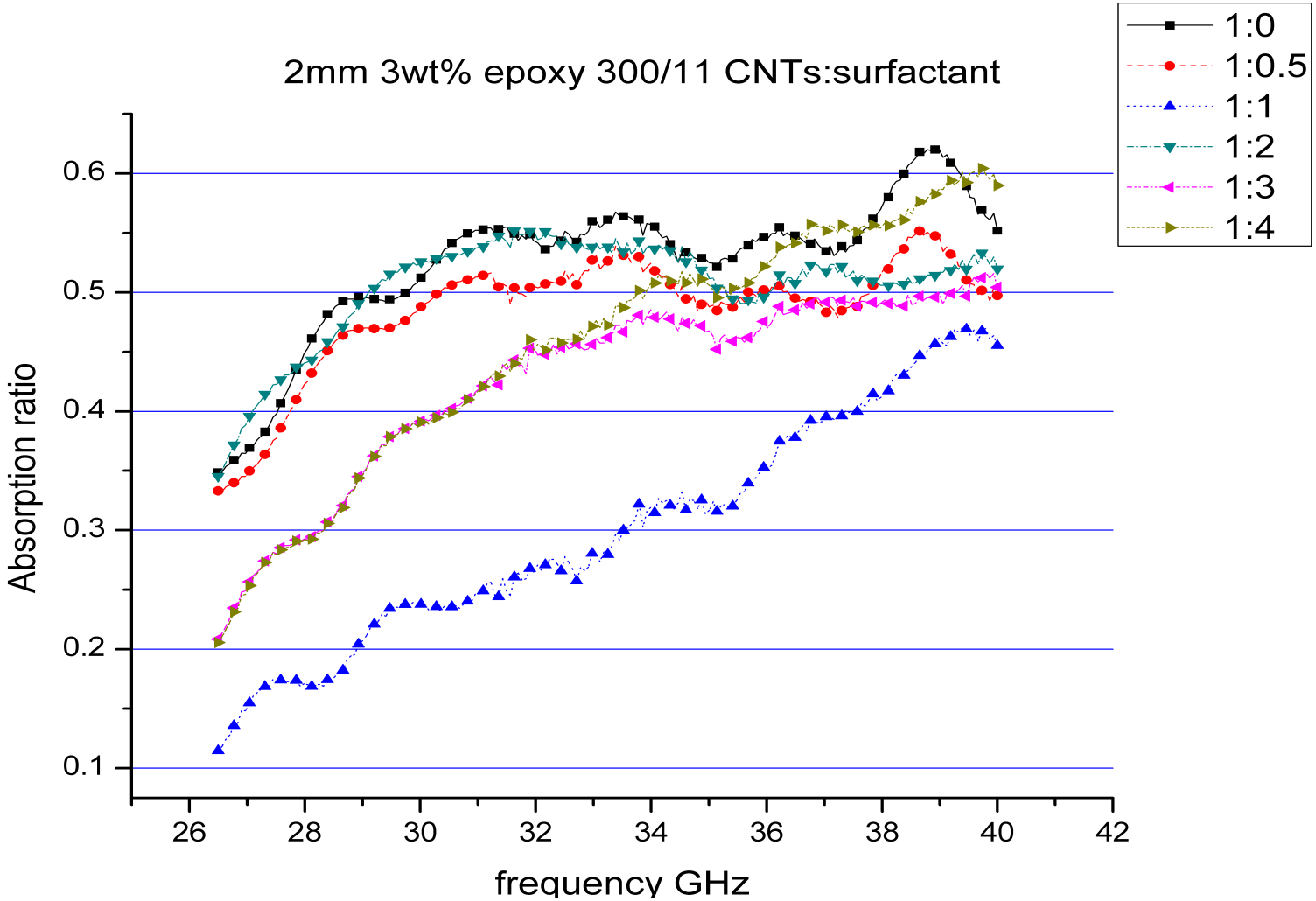
Figures 10 shows that the composites with different ratios of MWCNT/SDBS have different transmission loss properties.

Waveguide 3mm samples: Microwave Absorption ratios



Figures 11 shows that the composites with different ratios of MWCNT/SDBS have different absorption ratios.

Waveguide 2mm samples: Microwave Absorption ratios



Figures 12 shows that the composites with different ratios of MWCNT/SDBS have different absorption ratios.

Conclusion

- The results showed that SDBS influenced the microwave absorption properties with different dB values at different frequency ranges.
- The microwave absorption properties of the composites samples strongly depend on different SDBS ratios.

Acknowledgment

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Thank You

Questions?