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나창호 사장님,

본 보고서를 "전파 흡수 소재 BSM 502 의 물질 상수 측정 및 휴대폰 방사 패턴 변화 연구"의 최종 연구 보고서로 제출합니다.

전자전기공학과
박위상 교수

박위상

4. Conclusions

We have measured the material constant of BSM 502, a material developed by Ban Seok Material Development Company which absorbs the electromagnetic energy emitted by cellular phones, using the coaxial line reflection/transmission method over the frequency range 0.5 to 2.0 GHz.

At 835 MHz the complex relative permittivity of the material was 48.7 – j 12.7, and the relative permeability was 0.724 – j 6.56. Using these results, the attenuation constant was calculated as 241 Np/m and the propagation constant as 208 rad/m. The fact that these two constants are nearly the same magnitude implies that the material contains some ingredients of large conductivity. A plane wave of 835 MHz impinging vertically on a planar slab of 1.00 mm thickness made of the material has the reflection power ratio of 11.2 %, the transmission power ratio of 62.4 %, and the absorption power ratio of 26.4 %. Therefore, the material has a high absorption power ratio and a low transmission power ratio, making it a superior absorption material.

A simulation using the FDTD method was conducted to find the radiation intensity of a dipole antenna with and without a small absorber made of the material. The absorber had dimensions of 10 x 10 x 5 mm, and was located 10 mm from the dipole. As expected, the radiation intensity decreased in the shadow area of the absorber. The decrease was 3.2 dB when the distance from the dipole was 27.5 mm, and 1.3 dB when the distance was 32.5 mm. Therefore, we conclude that a small absorber made of the material, if attached between the monopole antenna of a cellular phone and the human head, has the effect of decreasing the SAR on the human head near the antenna.

References

[1] Hewlett-Packard Product Note Number 8510-3, Measuring Dielectric Constant with the HP 8510 Network Analyzer, The Measurement of Both Permittivity and Permeability of Solid Materials.

[2] Constantine A. Balanis, *Advanced Engineering Electromagnetics*, pp. 220 ~ 236, New York, John Wiley & Sons, 1989.

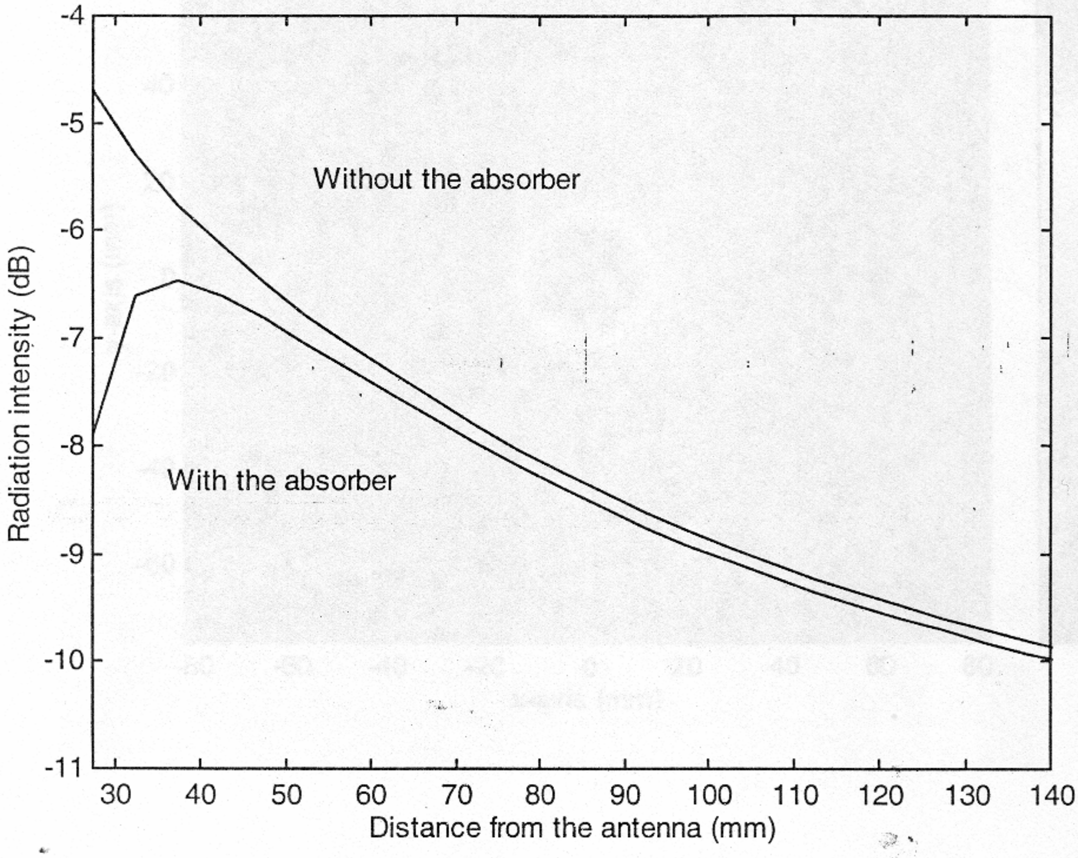

Figure 9. Comparison of the radiation intensities, with and without the absorber, versus the distance from the antenna. The horizontal axis, which is a part of the x-axis, represents the distance from the antenna, and an antenna voltage source is located at x = 0. The antenna is a dipole of 165 mm long. The absorber's dimensions are 10 x 10 x 5 mm, and its center is 15 mm from the antenna. The two graphs compare when the distance is greater than 27.5 mm in the shadow area. The decrease in the radiation intensity due to the presence of the absorber is 3.2 dB when the distance is 27.5 mm, and 1.3 dB when the distance is 32.5 mm.

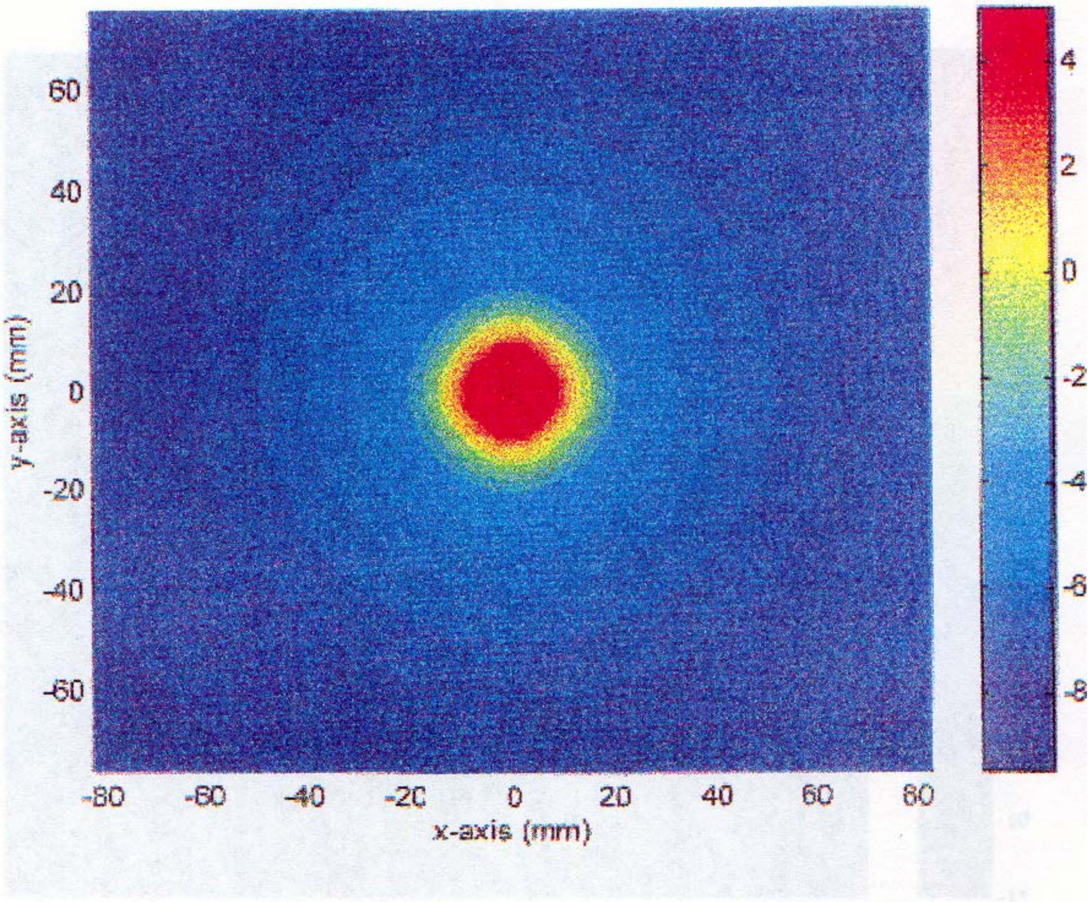

Figure 8. Contour plot for the radiation intensity pattern on the z = 0 plane when the absorber is absent. The horizontal axis represents the x-axis, and the vertical axis the y-axis. The colored column on the right has the unit of dB and indicates relative quantities. Note that the pattern is omnidirectional around the antenna at the center.

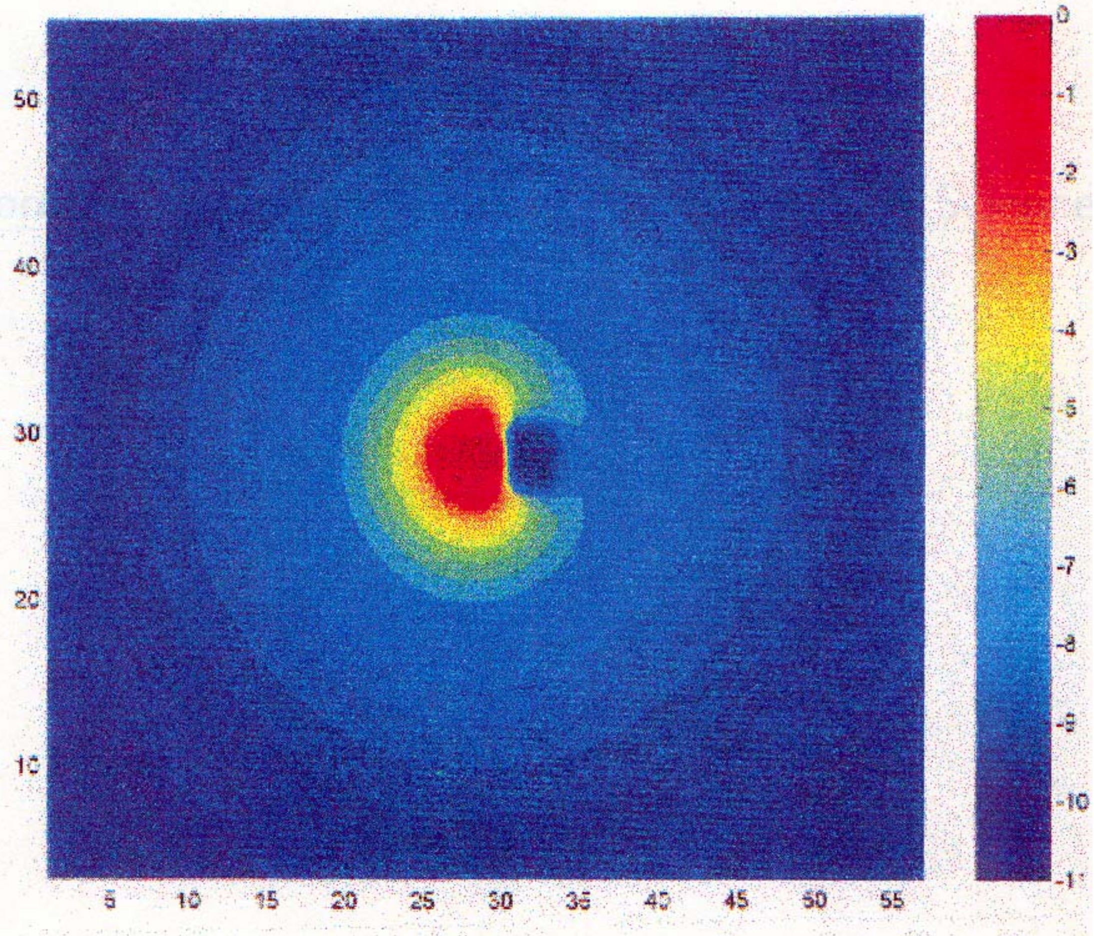

Figure 9. Contour plot for the radiation intensity pattern on the $z = 0$ plane when the absorber is present. It is observed that the radiation intensity in the shadow area, caused by the presence of the absorber, is much weaker than in the opposite area across the center.