Directional Monopole Antenna with Low Back-Radiation using Metamaterial Absorber

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This paper proposed the directional monopole antenna with low back-radiation using a metamaterial absorber. To realize the proposed idea, we designed the vertical monopole antenna with a ground plane and the low-profile metamaterial absorber is loaded in parallel to the wire monopole antenna. The monopole antenna without the metamaterial absorber has a resonance frequency of 2.7 GHz and peak gain of 3.7 dBi. On the other hands, when the metamaterial absorber is loaded, the proposed antenna has a directivity in the opposing side of the metamaterial absorber. In addition, the peak gain is increased from 3.7 dBi to 6.46 dBi by 2.76 dB.

Figure 1(a) illustrates the proposed wire monopole antenna with the metamaterial absorber. The wire monopole antenna has been designed by $\lambda/4$ size to operate at 2.7 GHz. The fabricated metamaterial, which is shown in the inset of Fig. 1(a), shows 90% absorptivity at 2.7 GHz. Figure 1(b) shows the simulated and measured reflection coefficient results with and without the metamaterial absorber. Initially, the simulated reflection coefficient of the monopole antenna without the metamaterial absorber is -27 dB at 2.7 GHz. Its measured reflection coefficient is -18 dB at 2.7 GHz. When the metamaterial absorber is loaded on the monopole antenna, the resonant frequency is slightly changed to 2.65 GHz because of coupling. Nevertheless, the simulated and measured reflection coefficients are -17 dB and -13 dB at 2.7 GHz, respectively.

Figure 2 shows the simulated and measured 3D radiation patterns. Without the metamaterial absorber, the simulated and measured peak gain of the monopole antenna is 3.71 dBi and 4 dBi, respectively, as shown in Fig. 2 (a) and (c). On the other hands, when the metamaterial absorber is loaded on the monopole antenna, the radiation pattern becomes directional and the peak gain is increased from 3.71 dBi to 6.46 dBi by 2.76 dB in EM simulation as shown in Fig. 2(b). The measured peak gain is increased from 4 dBi to 5.95 dBi by 1.95 dB as shown in Fig. 2(d).

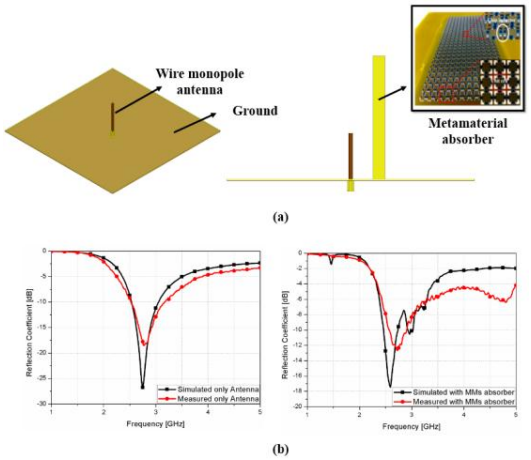

Figure 1. (a) Illustration of the proposed wire monopole antenna loading the metamaterial absorber absorber (b) Simulated and measured reflection coefficient without the metamaterial absorber.

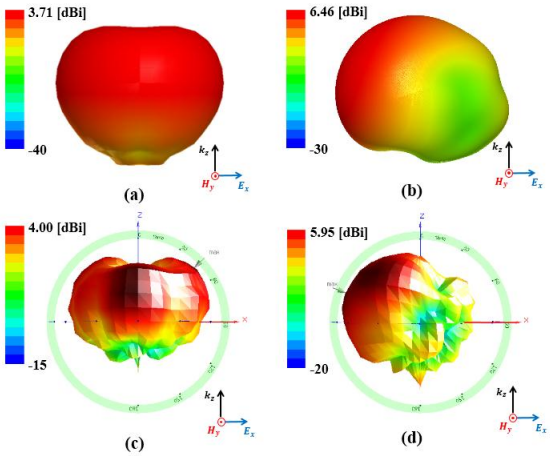

Figure 2. Simulated and measured 3D radiation patterns: Simulation (a) without and (b) with the absorber Measurement (c) without and (d) with the absorber

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