Metasurface Loss Analysis for 1D TCDA Efficiency Improvement

Seongjung Kim[1] **and Sangwook Nam**[2]
School of Electrical and Information Engineering
Seoul National University, Korea
[1]sjkim@ael.snu.ac.kr, [2]snam@snu.ac.kr

ABSTRACT To implement 1D TCDA [1], a metasurface is used to satisfy the boundary condition of dual polarization dipoles. To satisfy the boundary conditions of vertical and horizontal dipoles, the PMC and PEC boundary condition are required on both sides respectively, as shown in Fig. 1. A thin ferrite sheet and conductor strips were used to satisfy both boundary conditions simultaneously [1]. Because the conductor strips are arranged vertically, they are coupling with only the horizontal dipoles.

However, since the metasurface is a periodic structure, resonance can occur at a specific frequency. When some current flows around the ferrite sheets, a high loss and low efficiency occurs, particularly when there is a resonance. Fig. 2. shows the unit cell structure and the distribution of loss density of the one lambda resonance in the ferrite sheet due to horizontal dipoles. The vertical dipoles have little coupling to the conductor strips; thus, there is little radiation efficiency degradation.

To solve this problem, we propose a modified metasurface with partially removed conductor strips. In Fig. 2., we will remove the only two conductor strips that produce strong losses, corresponding to the yellow parts. Removing only two of the 12 conductor strips has little effect on the horizontal dipoles' boundary condition. Fig. 3. shows the radiation efficiency of the horizontal dipoles before and after partially removing the conductor strips. The proposed metasurface has improved radiation efficiency from 42 to 70 percent at resonance frequency 1.3GHz.

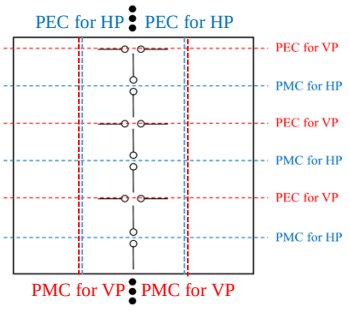

Fig. 1. The boundary condition of 1D TCDA.

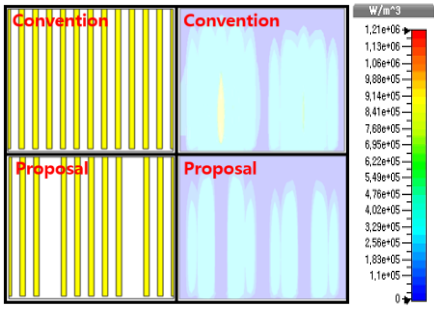

Fig. 2. The structures and loss density.

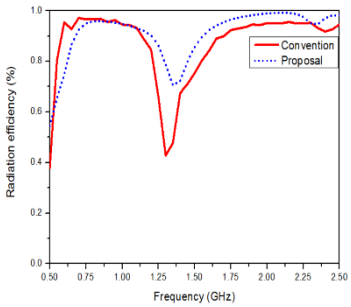

Fig. 3. The radiation efficiency.

ACKNOWLEDGMENT "This work was supported by the Center for Advanced Meta-Materials(CAMM) funded by the Ministry of Science, ICT and Future Planning as Global Frontier Project" (CAMM-2014M3A6B3063700)

REFERENCES

1. H. Lee and S. Nam, "A Dual-Polarized 1-D Tightly Coupled Dipole Array Antenna," in *IEEE Transactions on Antennas and Propagation*, vol. 65, no. 9, pp. 4511-4518, Sept. 2017.