Relation Between Input Impedance and Near Field Distribution on RFID Reader Antenna

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1 Introduction

Radio frequency identification (RFID) is one of the most promising technologies for wireless identification system and sensor work system[1]. Success rate of reading tags is an important issue for some important RFID applications, such as smart-shelf system[2]. Detection area confinement is also a significant issue in one of the RFID application: smart-shelf system. The tags can only be detected when they are really close to the reader antenna; otherwise, the goods cannot be managed perfectly. In this study, the effect of parameters of a planar waveguide sheet on its input impedance and near field distribution is clarified to confine the detection area of the RFID systems.

2 Parametric Studies

Smart-shelf systems are using RFID system as the transmission protocol. A planar waveguide sheet provided by Teijin Limited is used as a reader antenna of a smart-shelf system. The geometry of a planar waveguide sheet is shown in Fig. 1 The planar waveguide sheet consists of three layers: conducting mesh layer (top layer), dielectric substrate layer (middle layer), and conducting ground plane (bottom layer). The top layer of the sheet used in smart-shelf system consists of delta meshes. Three parameters of the delta mesh are studied: length of the base-line s_t and the degree between the base-line and the other side θ, and the width of the conductive line w_s.

The electric field distribution on z-component is analyzed by using method of moments. Through varying s_t and θ, it is known that varying parameters of the delta mesh in the top layer affects the electric field distribution near the sheet. It is also shown that the larger w_s decrease the electric field intensity directly above the sheet.

The planar waveguide sheet works in different frequencies is investigated. The working frequency is varied from 800MHz to 1GHz, s_t=29 mm, and θ=60°, the input impedance of the sheet and the electric field distribution are shown in Fig. 2 and Fig. 3, respectively. It demonstrates that the sheet with high resistance has more concentrative electric field distribution on the sheet.

3 Conclusions

In this study, the effect of the geometrical parameters of the sheet on its performance as a RFID system was clarified. The parameters of the sheet affect the amount of energy leaking to the free space. It was shown that the parameters of the delta mesh in the top layer of the sheet affects the electric field distribution. It was found that the electric field of the planar waveguide sheet is intensively focused on the sheet when the real part of input impedance of the sheet is large.

Reference

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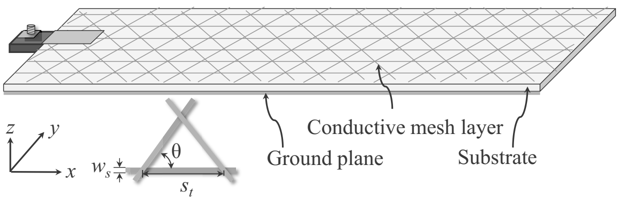

Fig. 1 Geometry of planar waveguide sheet.

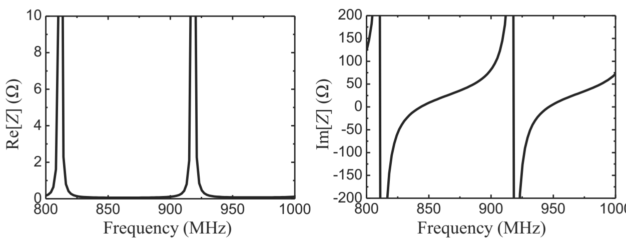

Fig. 2 Input impedance of planar waveguide sheet with s_t=29mm.

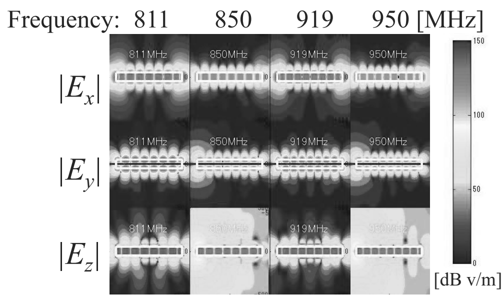

Fig. 3 $|E_z|$ on sheet with different working frequency.