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Feasibility Study of Optically Transparent Microstrip Patch Antenna

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FEASIBILITY STUDY OF OPTICALLY TRANSPARENT MICROSTRIP PATCH ANTENNA

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SUMMARY

The paper presents a feasibility study on optically transparent patch antennas with microstrip line and probe feeds. The two antennas operate at 2.3 GHz and 19.5 GHz respectively. They are constructed from a thin sheet of clear polyester with an AgHT-8 optically transparent conductive coating. The experimental results show good radiation patterns and input impedance match. The antennas have potential applications in mobile wireless communications.

INTRODUCTION

The conventional microstrip line fed patch antenna constructed from RT-Duroid 5880 ($\varepsilon_r = 2.2$) substrate is not optically transparent. Several applications involving vehicular communications and navigation require antennas which are conformal and optically transparent. These special antennas are not only required for communications and navigation but are also necessary to enhance the vehicle performance, such as, security and aesthetics. This paper presents the results of a study conducted to determine the feasibility of a planar optically transparent antenna at microwave frequencies.

TRANSPARENT PATCH ANTENNA

Construction

Figures 1(a) and (b) illustrate the construction details of the optically transparent patch with microstrip line feed and probe feed respectively. Since wet chemical etching was not possible, the antenna was fabricated by cutting out the patch and the feed from the coated polyester sheet. The coating has a surface resistance of about 6 to 10 Ω per square (ref. 1). The thickness of the polyester sheet is 7.5 mils. An overhead transparency sheet of thickness 3.5 mils is introduced between the patch and the lower ground plane to obtain a total substrate thickness of 11 mils. The plexiglass block in figure 1(a) and the aluminum ground plane in figure 1(b) simply provide support for the coaxial connector.

Measured Characteristics

The measured E- and H-Plane radiation patterns for the patch with microstrip feed are shown in figures 2(a) and (b) respectively. The measured return loss and input impedance are shown in figures 3(a) and (b) respectively. Figures 4(a) and (b) shows the measured E- and H-Plane radiation patterns respectively for the patch with a probe feed. Figure 5 shows the measured H-Plane cross polarization. As expected there is a deep null at bore sight. The

input impedance is shown in figure 6. The above patterns when compared to those of conventional patch antenna are observed to be similar. Further, the above measurements indicate that it is possible to obtain good impedance match as in the case of conventional patch antenna.

CONCLUSION AND DISCUSSIONS

The feasibility of constructing an optically transparent patch antenna has been demonstrated. The measured radiation patterns, return loss and input impedance of the antennas have been presented. Based on the above preliminary results we are confident that this concept can be further developed to produce arrays for practical applications.

REFERENCE

1. Courtaulds Performance Films, AgHT Product Line Data Sheet.

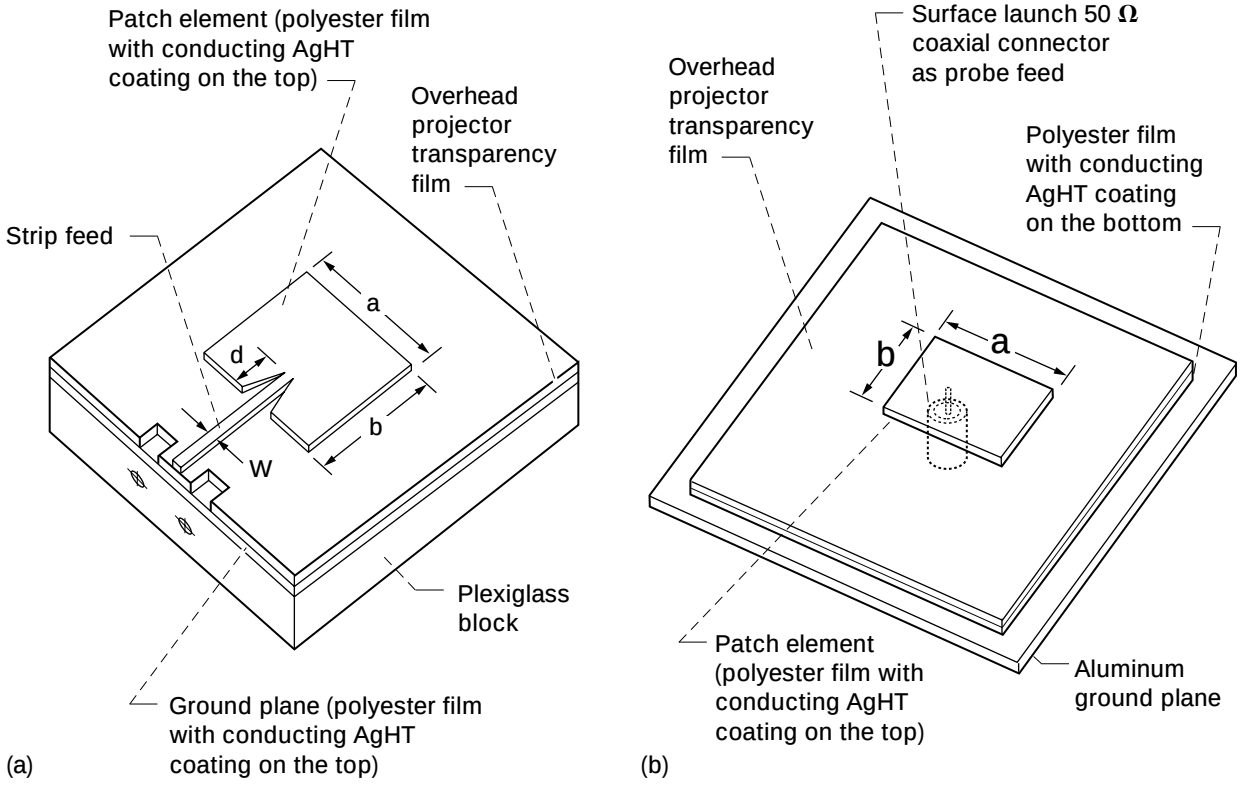

Figure 1.—Schematic illustrating the construction of the optically transparent patch antenna. (a) Microstrip line feed. a = 53 mm, b = 37 mm, d = 8 mm, w = 2 mm. (b) Probe feed. a = 9 mm, b = 7 mm.

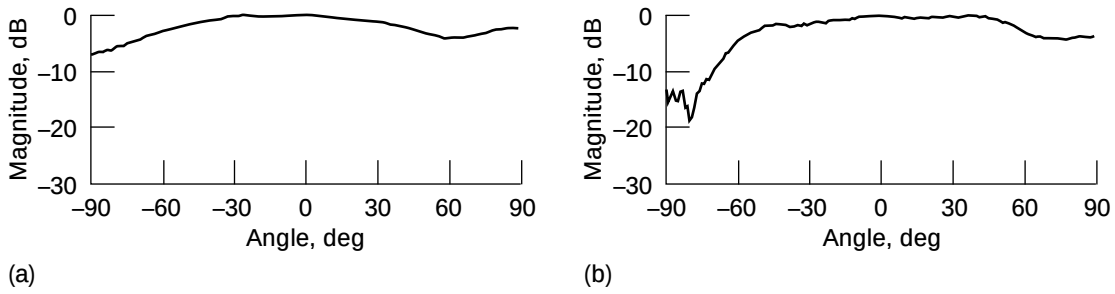

Figure 2.—Measured radiation pattern of the patch with microstrip feed at 2.3 GHz. (a) E-plane. (b) H-plane.

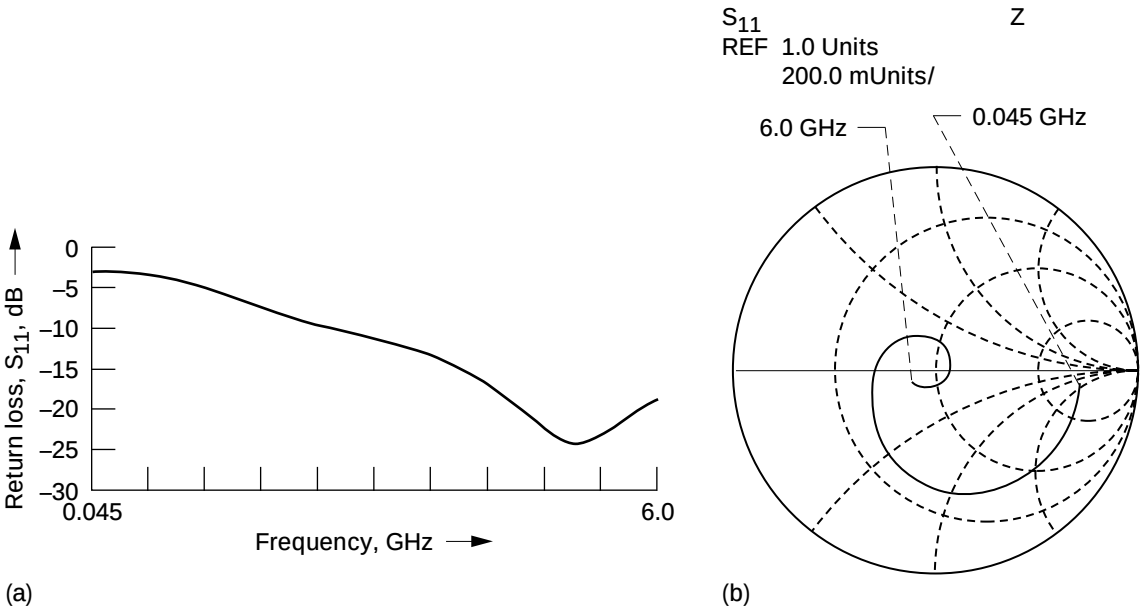

Figure 3.—(a) Measured return loss of the patch with microstrip feed. (b) Measured input impedance of the patch with microstrip feed.

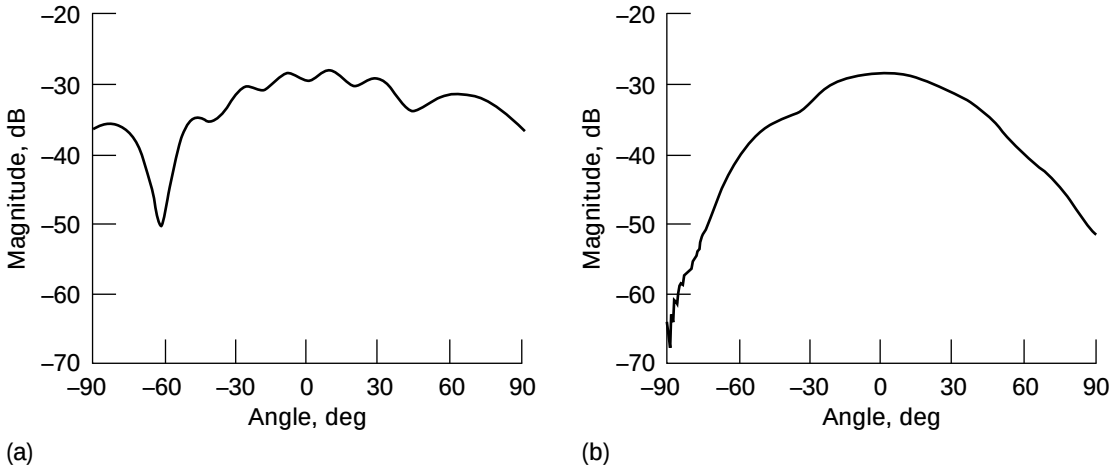

Figure 4.—Measured radiation pattern of the patch with probe feed at 19.5 GHz. (a) E-plane. (b) H-plane.

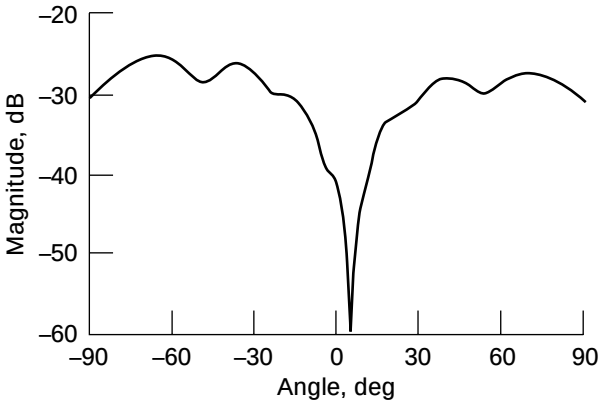

Figure 5.—Measured H-plane cross-polarization of the patch with probe feed.

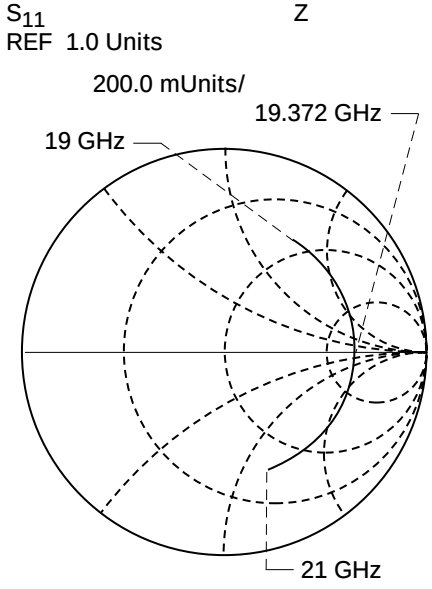

Figure 6.—Measured input impedance of the patch with probe feed.

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