An Investigation of Meshed Printed Monopoles for Optically-Transparent Antennas

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Meshed antennas have recently attracted interest for applications where optical-transparency is required [1]. For additively manufactured antennas, the conductive ink used and subsequently the cost of the antenna can be significantly reduced by meshing the antenna's conductors and ground plane [2]. Despite their wide presence in microstrip patch antennas [3] and more recently for complex-impedance dipoles [2], wide-band coplanar waveguide (CPW) antennas have not been explored with meshed radiators or ground planes. In this paper, a 2.4 GHz monopole is designed and characterized numerically and experimentally for various mesh fill-factors, showing over 2.3 dBi measured gain for up to 93% theoretical transparency.

For a meshed antenna, the theoretical transparency is given by

$$\text{Transparency} = (1 - \frac{W_t}{W_G})^2 \tag{1}$$

where W_t and W_g are the trace and gap width, respectively [1]. The proposed antenna is a $\lambda/4$ CPW monopole directly printed, using dispenser printing [2], on a flexible 75 μm-thick polyimide substrate, shown in Figure 1. The antenna's simulated bandwidth and radiation efficiency are shown in Figure 1, demonstrating that over 92% antenna efficiency can be maintained by the antenna for up to 93% transparency. When measured experimentally,

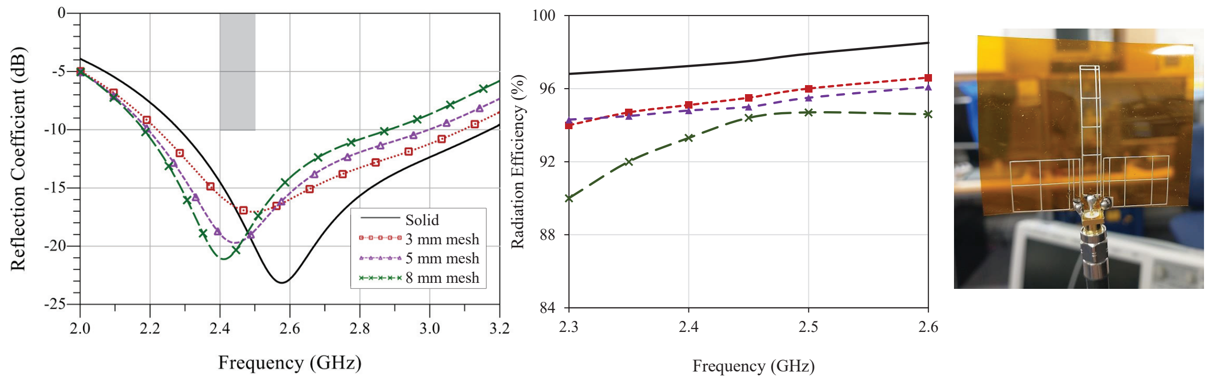

Figure 1. The reflection coefficient and radiation efficiency of the CPW monopole for varying gap size; photograph shows the 93% meshed monopole.

the prototypes with W_G=5 and 8 mm achieved a gain over 2.3 dBi with under 0.2 dB variation between both prototypes. Moreover, both antennas' $S_{11} < -10$ dB bandwidth covers the 2.4 GHz band. It is concluded that meshed printed antennas are suitable for ISM-band applications, enabling optical transparency and lower costs compared to their solid counterparts.

References

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