Design of Broadband Microwave Radome for 7 GHz – 20 GHz

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A radome is an electromagnetic window which can be manufactured into a desired shape and is conventionally used in ground based systems as well as on aircraft, missiles, and other flight vehicles carrying radar or other microwave equipment. In the design of a radome, the offsetting goals of structural integrity and electromagnetic transparency compete and depend upon the particular environment in which the radome is to be used. In many applications, the radome must allow transmission of electromagnetic energy over a broad bandwidth. The single-layer design using a homogeneous dielectric constant material has resulted in problems, when the material used in their construction are resonant to a given frequency for which it is designed. This causes the transmission and other electrical properties to degrade when the thickness causes an out of resonance condition. The degradation to electromagnetic energy transmission can be reduced by reducing the material thickness of a thin wall radome because the material is reduced to a lower percentage of the wavelength of the energy being passed through, but creates a problem of providing the necessary structural rigidity for the desired applications.

Based upon the foregoing, it is a main objective of the present work to provide a radome or electromagnetic window construction which may be suitably formed to any shape or size to enable adequate protection of an antenna which is radiating or receiving electromagnetic energy in the range from 7 GHz to 20 GHz or above. Basically, it can cover large application range for commercial purpose with improved functionality and performance. Specific characteristics that have been focused in this study are the low harmonic content of the frequency response, high transmission and low reflection.

This work presents a FSS based broadband microwave radome (7 GHz to 20 GHz) using ABS in sandwiched configuration as shown in Fig.1a. It allows excellent transmission efficiency over the entire spectrum of 7 GHz to 20 GHz. The final unit cell of 10mm size can be schematically represented by Fig.1b. The radome wall construction comprises a copper mesh structure sandwiched between two layers of ABS substrates. The HFSS simulated results show that for the frequency range -7 GHz to 18 GHz, S_{21} is below -0.3 dB and S_{11} is between -10 dB to -40 dB. The measurement results of the fabricated sample for the frequency range 7 GHz to 20 GHz are also in the close agreement with the simulated results.

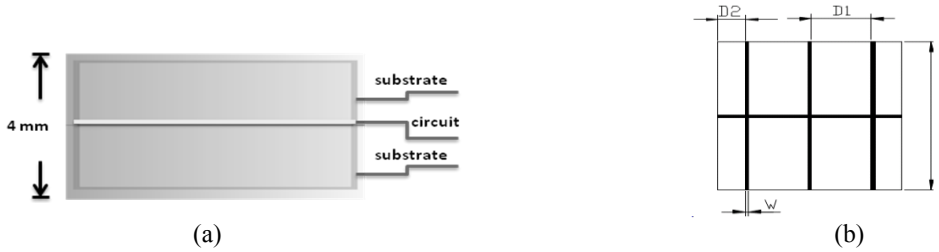

Figure 1: (a) Sandwich configuration of proposed structure, and (b) Schematic of unit cell (D1=4mm, D2=0.85 mm, W= 0.1 mm).