A Photonic Bandgap Antenna Reflector for PCS Applications

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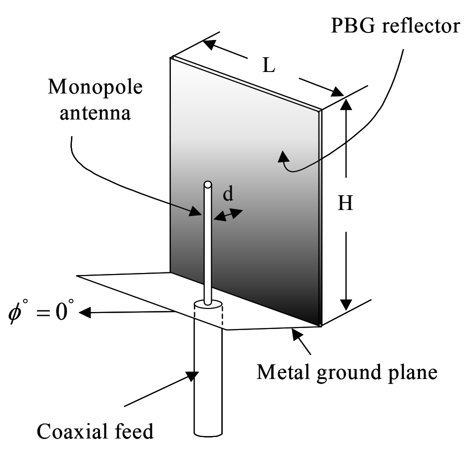
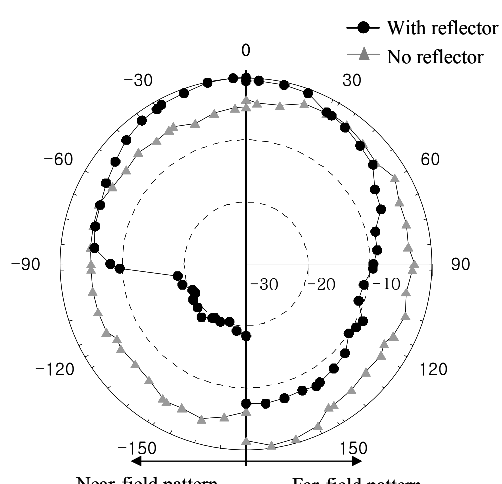
Photonic bandgap substrates possess a property unattainable from ordinary metal plates and present a large surface impedance near the resonant frequency. They could be placed inside a waveguide to obtain a desired electromagnetic field distribution or in the ground plane of microstrip circuits to form bandpass filters. The radiation pattern in open space could also be enhanced with the use of the PBG substrates as the antenna ground plane. In this paper, we propose the idea of using a small antenna reflector to purposely create a near-field null behind the reflector while maintaining a relatively uniform radiation pattern in the far field. Positioning a metal reflector near the transmitting antenna blocks the radiation itself. The PBG reflector, on the other hand, has little affect on the amount of total radiated power while reducing the near-field power potentially harmful to mobile phone users in personal communication systems. In our experiment, the two-layered thumb-tack approach proposed by Sievenpiper was initially used to fabricate the PBG substrate with the resonant frequency of 2.0GHz. Several different PBG reflector sizes were tested by placing them 3mm away from a simple monopole antenna. In the near field, the PBG reflector with the width of a half free-space wavelength provided an effective shielding with the front-to-backside radiation ratio of almost 20dB. However, the radiation pattern in the far field showed less than 8dB deviation from the pattern measured without any reflectors.



(a)



(b)

Figure1. (a) Reflector antenna test setup, and (b) normalized H-plane patterns measured at 0.2λ and 13λ away from the monopole, respectively. The PBG reflector, λ/2 by λ/2 in size, was placed 0.03λ away from the transmitting monopole antenna to provide the near-field shielding. The far-field pattern shows only 10dB peak-to-null ratio and a smaller field distortion compared to the near-field case.