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RESEARCH ARTICLE

Study of Micro-strip patch using band gap structure

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Impressive progress in the new and emerging area of

Abstract

PBG engineering in recent years has the potential to provide a simple and effective solution to the problems of surface to the problems of surface and leaky waves. A PBG crystal is a periodic structure that forbids the propagation of all electromagnetic wave within a particular frequency band called the band gap. In this paper a novel approach for gain and bandwidth enhancement of micro-strip patch antennas based on the emerging PBG technology has been demonstrated. Th
e design technique is simple to implement and fully compatible with standard planer fabrication technology. The multifold improvement in antenna performance make this new design approach useful for a wide range of application at microwave and mm-wave frequencies.

Introduction

Printed antennas exemplified by the micro-strip patch antenna offer an attractive solution to compact, conformal and low coast design of modem wirless communications equipment, RF sensors and radar systems. Recent applications have pushed the frequency well into the ram wave region even in the commercial arena vas evidenced by the worldwide race to develop advanced collision warning radar system for automobiles at the 76 GHs band. [1] Micro-strip-based planar antennas fabricated on a substrate with a high dielectric constant (Si, GaAs and Inp) are strongly preferred for easy integration with the MMIC RF front-end circuit. However, it is well known that patch antennas on high dielectric constant substrates are highly inefficient radiators due to surface wave losses and have very narrow frequency bandwidth. This situation becomes extremely severe as applications move to higher frequencies, resulting in patch antennas with reduced gain and efficiency as well as an unacceptably high level of cross polarization and mutual coupling within an array environment. Therefore, much effort has been made recently , to realize high efficiency, patch antennas on high permittivity substrates, including using the latest micromachining technology.[2,3] Although original research has been focused in the optical, [4,5] PBG structure are readily scalable and applicable to a wide range of frequencies, including microwaves and mm waves.[6] for example, several types of micro-strip-based PBG structure have been developed recently and their wide range of applications demonstrated (via. Various prototypes) including harmonic tuning for high efficiency power amplifiers, spurious-free band-pass filters and leaky-wave suppression in conductor backed coplanar waveguides. [7-9] Full wave electromagnetic characterization of PBG materials has been studied comprehensively by utilizing both finite-difference time domain (FDTD) [10] and finite element method. In this paper proposes a novel 2-D PBG lattice that is designed specifically to enhance the performance of micro-strip patch antennas.

Study of Micro-strip patch using band gap structure

The dominant surface wave in most practical micro-strip patch antennas on a grounded dielectric substrate is the **T** [M.Sub.O] mode, which has no cut off frequency. Therefore, a 2-D lattice that can prohibit the propagation of the **T** [M.Sub.O] mode along the dielectric substrate was sought. Fig. shows a schematic of the proposed 2-D PBG structure, which consists of a square lattice of small metal pads with grounding via in the center. This structure can be regarded as the planar version of a more general three-dimensional metallodielectricPBG crystal reported recently. Comprehensive full wave electromagnetic simulations based on the FD TD method in association with proper absorbing and periodic boundary conditions have been performed to analyze the propagation characteristics of this PBG lattice.

PBG PATCH ANTENNA DESIGN

Once the proper PBG lattice for surface wave suppression has been determined, the PBG antenna design is straight forward. The patch antenna is designed in a conventional fashion by itself and then surrounded properly by the 2-D PBG lattice. A reference patch antenna on a conventional dielectric substrate (without PBG) has also been constructing for comparison. The substrate used is RT / Duroid with [[Epailon].sub.r]=10.2 and 25 mil thickness. An inset feed scheme is used here to match the patch antenna to a 50[omega]micro-strip feed line, although other techniques such as offset feeding at the non-radiating edge, coaxial probe or aperture coupling may also be employed. The patch antenna is designed to work at approximately 14GHz so that the T [M.sub.O] surface wave it excites into the substrate will be suppressed with the PBG lattice. The patch size is 120 mil x 168 mil. The position of inset feed for optimal impedance matching is determined using an in-house FDTD code that takes approximately three to five minutes on a Pentium 11 PC to produce the broadband frequency response of a typical patch antenna. The total width of the dielectric substrate is 800 mil for both PBG and reference patch antenna, which corresponds to approximately one free-space wavelength at the center frequency. A relatively long (1.4 inches) micro-strip feed line is used to facilitate the E-plane pattern measurement.

Conclusion :-

A novel approach based on the emerging of PBG technology has been demonstrated. The design technique is simple to implement and fully compatible with standard planar fabrication technology. The multifold improvement in antenna performance (wider bandwidth, improved gain, lower backside radiation and beam shape control) makes this new design approach useful for a wide range of applications at microwave and mm wave frequencies.

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