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Photonic Crystals with Gaps Created Using a Dual-beam Multiple Exposure Method

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Introduction

We present a technique for fabricating complex dual beam multiple exposure 2D and 3D bandgap template structures in a photosensitive material. The planar interference pattern produced by the two laser beams and the system parameters relating to the sample's reorientation effect in regard to these planes are discussed. The dimensional square and hexagonal arrays of dielectric rods and holes are examples of photonic crystal structures. Artificially created structures called photonic crystals can show a band gap for photons, just like semiconductor materials do for electrons. Thanks to photonic band gap materials, the optical designer now has a new method for producing the optical devices of the future. Several of these have been demonstrated in the past [1].

Description

The structure of a photonic crystal with a full band gap frequently has high dielectric contrast and translational symmetry. The optical crystal's flaws are what because the defect states in the optical band gap. These flaws can be used to limit light to follow waveguides with sharp bends, as in integrated optic devices, or to provide wave guiding in a low dielectric region, as in many band gap fibre architectures [2]. In addition to the work being done on translationally periodic photonic crystals, studies and research findings suggest that photonic band gaps can be observed in quasi-periodic dielectric structures. Photonic band gaps in stacked multi-layer dielectrics have been demonstrated by early research.

In a number of quasi-periodic systems where the rotational symmetry revolves around a pattern centre, complete photonic band gaps have recently been discovered. The absence of photonic crystal-like long-range translational symmetry in the rotationally symmetric quasi-crystals suggests that the band gap may be related to the dielectric material's shorter-range ordering [3]. In photonic quasi-crystal structures, typically 2D arrays of rods arranged in the N-fold rotational symmetry, the level of dielectric contrast can be somewhat relaxed and the isotropy of the band gap is more uniform with respect to the propagation angle. The use of rods in the pattern can be attributed to the fact that the properties of photonic crystals scale with the lattice constant. Early microwave measurements on rod-type structured arrays can be used to confirm or at least support theoretical predictions of the optical properties of photonic quasi-crystals created for the various optical wavelengths of communication interest.

A dual beam multiple exposure holographic lithography system's ability to produce 12-fold rotationally symmetric quasi-crystal patterns is the subject of our theoretical investigation. The conventional rods and circular holes used in earlier quasi-crystal patterns can be significantly outperformed by this approach in terms of the geometry of the high- or low-electricity zones. On an e-beam resist coated substrate, it has recently been demonstrated that dual beam quasi-crystal patterns can be directly written to a scale appropriate for communication frequencies [4]. Twelve-fold quasi-crystal formations can be made using the dual beam technique. a program that was used to conceptually analyze the quasi-crystal patterns on the computer. In the final section, defects are introduced into the quasi-crystal pattern and numerous quasi-crystal devices [5].

Conclusion

The optical guiding and transmission properties of the polarized 2D structure have been demonstrated by us Using standard e-beam or optical holographic lithography, the fill-factor and dielectric contrast-based patterns can be written easily. In addition to other intriguing waveguide characteristics, it features a propagation that is largely independent of angle but is dependent on placement in relation to the centre of the quasi-crystal pattern. The optical and waveguide properties point to the possibility of developing novel and intriguing device designs.

Acknowledgement

None.

Conflict of Interest

None.

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