積層型ホールアレイを用いた透過位相制御

Wavefront control by stacked metal-dielectric hole array

Keyword

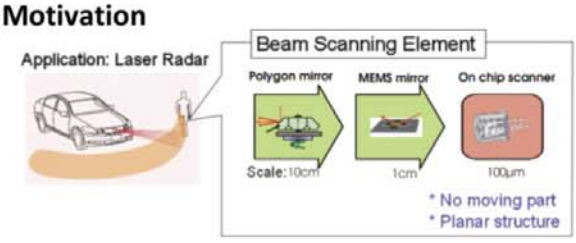
Plasmonics, Metamaterials, Subwavelength structures, Nanostructures

Introduction

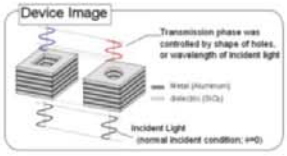
金属と誘電体の積層膜に、1辺の長さを徐々に変えた長方形のナノホールを形成し、透過光の波面を傾斜させることを試みた。電磁界解析と高精度のナノ加工によって、波長の1/6の膜厚のホールアレイで0.6πの位相差が得られことを実証した。この技術を利用し、ビーム走査デバイスの実現をめざしている。

A stacked metal-dielectric hole array (SHA) containing rectangular holes whose shape gradually varies in-plane is proposed as a means of achieving wavefront control. An in-plane phase difference of 0.6π using an SHA with a thickness of one-sixth of the wavelength has been experimentally demonstrated for 1-dimensional beam steering.

Motivation

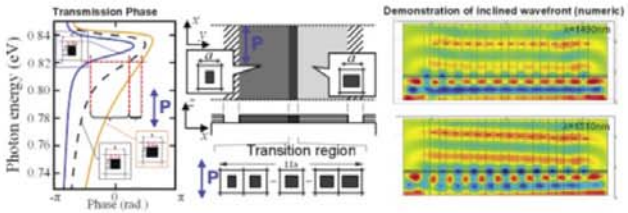


Transmission phase control is experimentally demonstrated using SHA for beam steering application.



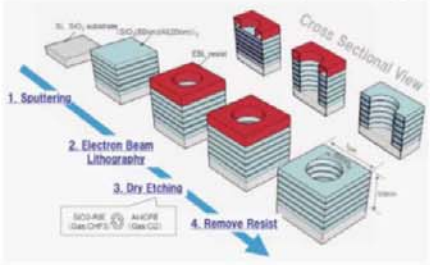
Concept

Transmission phase through rectangular holed SHA can be controlled by sides which is normal to polarization axis.



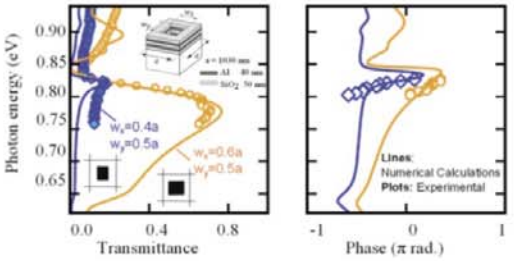
Fabrication Process

The SHA structure was fabricated by EB lithography.

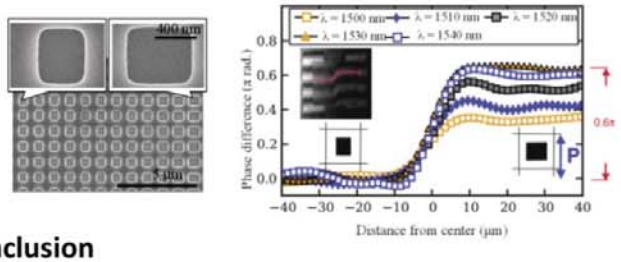


Results

Calculated and measured transmission spectra and phase indicate good agreement. Dispersion control of an SHA by varying the hole side length is experimentally confirmed.



An inclined wavefront can be formed by using a planar structure, which suggests the possibility of wavefront shape control based on the in-plane geometric design, i.e., the hole shape. The maximum phase difference observed in this study was 0.6π.



Conclusion

We experimentally revealed the controllability of transmission phase of the SHA. The structure have sub-wavelength hole array whose hole shapes were gradually changing from narrow rectangle to wide rectangle shape, to have beam steering functionality against small perturbation of incident wavelength.

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