

課題番号 : F-19-TU-0012
 利用形態 : 機器利用
 利用課題名(日本語) : Metamaterial for THz-wave photonic devices
 Program Title (English) : Metamaterial for THz-wave photonic devices
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 キーワード/Keyword : 成膜・膜堆積, リソグラフィ・露光・描画装置, film metamaterial, photolithography, THz wave device

1. 概要(Summary)

THz wave holds the unique fingerprint characteristics on many molecules, leading to the active researches on THz wave spectroscopy and THz wave image. We propose to use metamaterials for various THz applications such as remote sensing, nondestructive inspection and so on. We have designed double layer metamaterial device for THz wave phase manipulation. Through using the facility of μ SIC (micro system integration center) at Tohoku University, we have fabricated the double layer metamaterial in a film device. The developed film metamaterial has advantage of high transmission for THz wave, which is promise to THz wave applications.

2. 実験(Experimental)

【利用した主な装置】

両面アライナ露光装置一式、EB 描画装置、レーザ描画装置、芝浦スパッタ装置、電子ビーム蒸着装置、ダイサ、Tencor 段差計、デジタル顕微鏡、熱電子 SEM.

【実験方法】

We mainly use the photolithography technique to fabricate the metamaterial device. A polymer substrate is employed to accommodate the double layer micron metallic patterns. Wet etching process is applied for the metallic patterning. The minimum size of the metallic pattern is around 5 μ m, and the device area is over 35mm by 35mm. We begin with a handle wafer and finally the polymer substrate is released to obtain the film metamaterial device.

3. 結果と考察(Results and Discussion)

By several try and error tests, we have succeeded to obtain the film metamaterial device with releasing from the handle wafer, as shown in Fig. 1.

The micron array has a process yield close to 100%. THz wave time-domain spectroscopy measurement was carried out to characterize the developed device. The measurement results and simulation results agree well with each other.

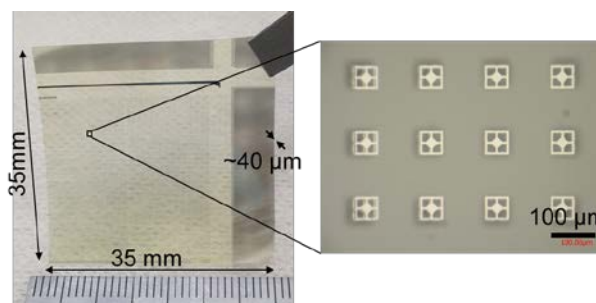


Fig. 1 Developed film metamaterial device.

4. その他・特記事項(Others)

Thanks to Prof. K. Totsu of Tohoku Univ., Prof. H. Ito of RIKEN/Tohoku Univ. and Prof. M. Kumano of Tohoku Univ. for fruitful discussions.

5. 論文・学会発表(Publication/Presentation)

- (1) Z. Han, S. Ohno, H. Minamide, "Phase jumping through control of resonator coupling," in Proc. 9th International Conference on Surface Plasmon Photonics (SPP9), May 26-31, 2019, Copenhagen, Denmark.
- (2) Z. Han, S. Ohno, and H. Minamide, "Phase singularity in double-layer metamaterial based on lattice resonance," 44th International Conference on Infrared, Millimeter and THz waves (IRMMW-THz 2019), We-Po3-90, Paris, France (Sep. 4, 2019).
- (3) Z. Han, S. Ohno, and H. Minamide, "Phase singularity in double-layer metamaterial," 第 80 回応用物理学会秋季学術講演会, 19p-E215-13, 北海道大学札幌キャンパス(2019 年 9 月 19 日).

6. 関連特許(Patent)

なし