

課題番号 : F-18-TU-0035
利用形態 : 機器利用
利用課題名 (日本語) : Micron pattern devices for THz image system
Program Title (English) : Micron pattern devices for THz image system
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1. 概要 (Summary)

THz wave holds the unique fingerprint characteristics on many molecules, leading to the active researches on the THz spectroscopy and THz image. We propose to use the micron pattern devices (or so called metamaterial) for various THz applications such as remote sensing, nondestructive inspection and so on. We have designed micron pattern devices working on THz frequency range. We use the facility of μ SIC (micro system integration center) at Tohoku University to fabricate the micron devices.

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 micron devices. A polymer substrate is employed to accommodate the micron devices. Wet etching process is applied for the metallic micron patterns. Since the minimum size is around $5\ \mu\text{m}$, it needs to take careful attention for the entire device process. We began with a handle wafer and finally the polymer substrate was released to obtain the film metamaterial device. The process optimization is under developing.

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%.

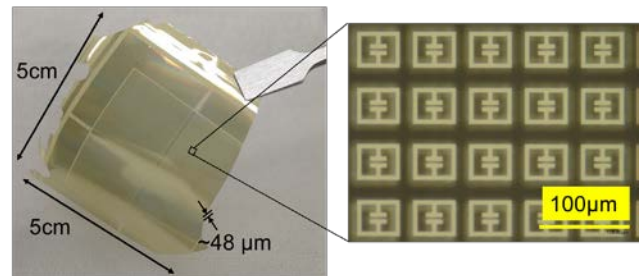


Fig. 1 Developed film metamaterial device.

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) Zhengli Han, Seigo Ohno, Yu Tokizane, Kouji Nawata, Takashi Notake, Yuma Takida and Hiroaki Minamide, "Off-resonance and in-resonance metamaterial design for a high-transmission terahertz-wave quarter-wave plate," Optics Letters Vol. 43, Issue 12, pp. 2977-2980 (2018)
- (2) Z. Han, S. Ohno, Y. Tokizane, K. Nawata, T. Notake, Y. Takida, and H. Minamide, "Double-layer USRRs for a thin terahertz-wave phase shifter with high transmission," Conference on Lasers and Electro-Optics (CLEO:2018), JW2A.100, San Jose McEnery Convention Center, San Jose, CA, USA (May 16, 2018).
- (3) Z. Han, S. Ohno, Y. Tokizane, K. Nawata, T. Notake, Y. Takida, and H. Minamide, "Near-field Coupling between Double-layer Metallic Patterns," in Proc. 15th International Conference of Near-Field Optics, Nanophotonics and Related Techniques (NFO15), Troyes, France, Aug 26-31, 2018.
- (4) Z. Han, S. Ohno, Y. Tokizane, K. Nawata, T. Notake, Y. Takida, and H. Minamide, "A high transmission terahertz-wave quarter-wave plate by double-layer SRRs with film metamaterial," 43rd International Conference on Infrared, Millimeter and THz waves (IRMMW-THz 2018), We-A2-1b-4, Nagoya Congress Center, Nagoya, Japan (Sep. 12, 2018).

6. 関連特許 (Patent)

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