

課題番号 : F-18-TT-0004
 利用形態 : 機器利用
 利用課題名(日本語) : 微細加工技術による立体サンプル形成と高機能化(マイクロヒータの製作)
 Program Title (English) : Fabrication of microdevice having 3D structure and functionality
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 検索キーワード : 形状・形態観察; Microheater; Thermal isolation; Heat capacitance

1. 概要(Summary)

Microheaters have been used for the infrared light source for the gas sensing, which have many applications. Based on the uniqueness of the absorption spectrum of the gas molecules, the gas selectivity is realized. In general, the higher temperature should be realized in the larger area using the lower input power for getting the larger infrared intensity. As the microheater device, the thermal isolation from the hot region to the cold region is required. The lower heat capacitance is advantageous. They will be realized using the thin and large structure based on the MEMS process taking the balance with the mechanical strength.

2. 実験(Experimental)

利用装置名: マスクレス露光装置, マスクアライナ装置, Deep Reactive Ion Etching 装置(非 Bosch プロセス), 洗浄ドラフト一式, デジタルマイクロスコープ一式など

Figure 1(a) shows the array of the microheaters during the Si etching. There are 9 different backside designs. Figure 1(b) shows the front side photo of one microheater with the backside illumination. Thin membrane shows the orange color. The white lines in that is the cracking. This indicates the design should be improved.

3. 結果と考察(Results and Discussion)

Checking the crack positions, the following tendency is confirmed. The larger the total membrane area, the higher the cracking risk. (1) Figure 2(a) shows the previous backside design giving the result as shown in Fig. 1(b). High cracking possibility is at outer donut region.

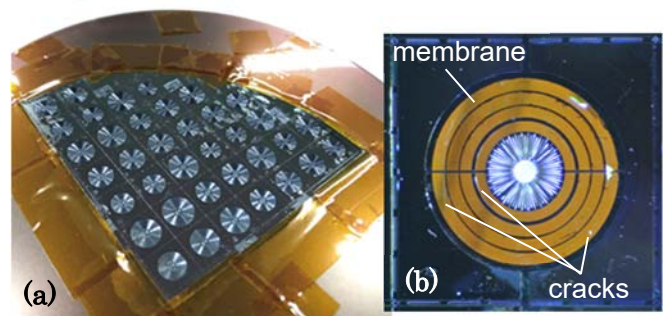


Fig. 1: (a) Array of the microheaters during backside Si etching. (b) Fabricated microheater suffering from the cracking of donut membrane.

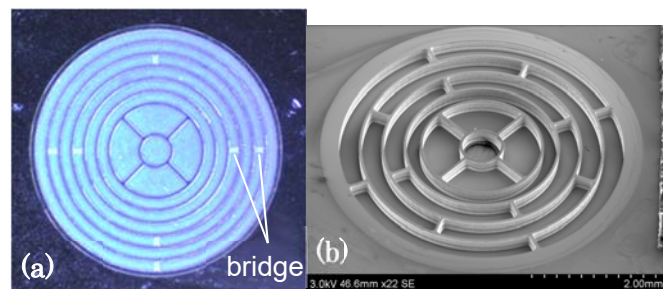


Fig. 2: Microheater backside showing (a) previous and (b) revised designs.

However, the narrower donut regions (width of $200\mu\text{m}$) doesn't show the clear difference compared to the wider regions (width of $300\mu\text{m}$). This indicates that the cracking occurs due to the twisting of the connecting bridge. (2) The center 4 pieces of fan regions don't suffer from the cracking even though it has the width of $645\mu\text{m}$. So, the support bridges connecting the rings is better to be 4 for avoiding the twisting of the membrane.

Figure 2(b) shows one improved backside design. The cracking is removed for all microheaters with nine different membrane sizes.

4. その他・特記事項(Others) No.

5. 論文・学会発表(Publication/Presentation) No.

6. 関連特許(Patent) No.

参考として

Yen-Wei Chang, 矢作秀賀, Hai Minh Nguyen, 佐々木実, “波長選択赤外光源用マイクロヒータ” 電気学会全国大会 予稿集 G408-C1, 3-173 (2019.3.14, 北海道).