課題番号　　:F-20-HK-0020
利用形態　　: 共同研究
利用課題名（日本語）　　:

Program Title (English)　　:GaN-based Microdisk Cavity Laser with Plasmonic Enhancement

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キーワード／Keyword　　:Microdisk, Cavity Laser, Plasmonic enhancement、リソグラフィ・露光・描画装置

1．概要（Summary）

Microdisk lasers feature low-loss, high-quality whispering gallery modes that offer the potential for ultra-low threshold lasing that is not limited by challenges in mirror fabrication. With the effects of the microdisk cavity being observed in GaN, a comparison between GaN microdisks with other conventional III–V semiconductors, say GaAs, can be made in order to provide a guideline for future GaN microdisk lasers. The obvious and attractive distinction of the GaN based microdisk is the working wavelength range in the blue and ultraviolet. In our research, we studied on the sample with the structure of GaN-based blue laser grown in SINANO, fabricating its nanostructure with different nano-pattern to get microdisk laser. Then we could combine the device with metal particles on the top or the side wall of the structure to create surface-enhanced plasmon for the signal enhancement.

2．実験（Experimental）

【利用した主な装置】

超高精度電子ビーム描画装置 (EBL, ELS-F125-U, Elionix); ヘリコンスパッタリング装置 (MPS-4000C1/HC1, ULVAC); 高分解能電界放射型走査型電子顕微鏡 (JSM-6700FT, JEOL).

【実験方法】

The GaN-based blue laser were grown in SINANO. The nano-hexagonal structures of microdisk of GaN laser was design and and fabricated of different sizes and shapes using High-resolution electron beam lithography (EBL, ELS-F125-U, Elionix); Helicon sputtering system (MPS-4000C1/HC1, ULVAC), and characterized by FE-SEM (JSM-6700FT, JEOL).

3．結果と考察（Results and Discussion）

Based on the structure, nanofabrication of mask-patterns needed subsequently to be prepared. After that the scanning electron microscopy (SEM) images of the hexagonal GaN microdisk arrays will be used for the characterization. The common approach is usually combined with EBL or FIB technology. Here we use another effective fabrication approach. Colloidal spherical particles of polystyrene (PS) beads were self-assembled to form a mask for fabricating nanostructures according to the schematic in Fig. 1. Figure 2 is a collection of the SEM images of PS spheres self-assembled on the top.

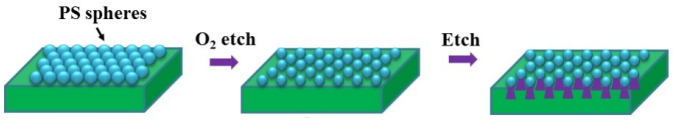

Fig. 1. Schematic of the processes for fabricating pattern on the Sample. (a) PS spheres self-assembled on the top. (b) O_2 etching process. (c) Deposit Ti film and remove PS spheres.

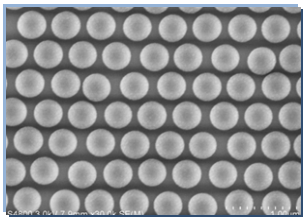

Fig. 2. Experimental top-view SEM image of PS spheres etched by oxygen plasma.

4．その他・特記事項（Others）

Main collaborators: H. Misawa (RIES-Hokkaido University).

5．論文・学会発表（Publication/Presentation）　なし

6．関連特許（Patent）　なし