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利用課題名（日本語）　:大面積レーザーアレイのためのペロブスカイト自己集合リソグラフィの研究
Program Title (English)　:Self-healing lithographic patterning of perovskite nanocrystals for large-area laser array
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キーワード／Keyword　:リソグラフィ・露光・描画装置、nanolasers, perovskite nanocrystals

1. 概要（Summary）

We propose a self-healing lithographic patterning technique to demonstrate large-area single-mode laser arrays based on perovskite nanocrystals (NCs). This self-healing lithographic patterning technique, has the unique advantages of being compatible with the standard top-down lithography processes and enabling the fabrication of high-quality, crystallinity, and precisely size-controlled optical cavities based on lead halide perovskites.

2. 実験（Experimental）

【利用した主な装置】

レーザー直接描画装置(DWL66+)、高精細電子顕微鏡(Hitachi Regulus 8230)、形状・膜厚・電気特性評価装置群(レーザー顕微鏡 LEXT OLS5000)

【実験方法】

The fabrication process was as follows. First, the OAP solution was spin-coated onto the substrate (4000 rpm for 30 s) and baked at 110℃ for 1 min. Second, an 800-nm photoresist (JSR 7790G) was spin-coated onto the substrate (6000 rpm for 30 s) and followed by baking at 110℃ for 1.5 min. Third, the laser patterns were patterned with the laser writer and developed by NMD-3 for 60 s. Subsequently, the $CsPbBr_3$ NCs were spin-coated (800 rpm for 30 s) on the patterned samples and dried in vacuum for 30 min. Then the dried sample was immersed in ethyl acetate to dissolve the photoresist. Finally, the sample was placed in methanol vapor atmosphere for 24 hours.

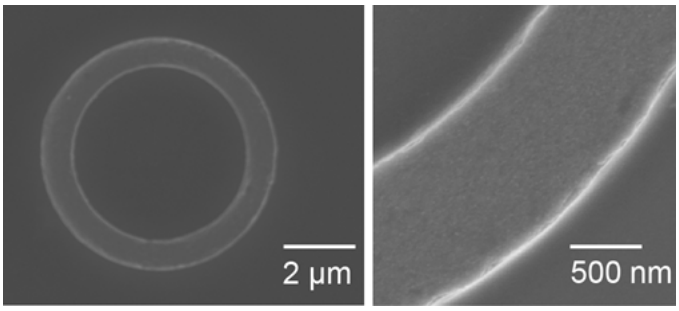

Figure 1. SEM images of the microring laser cavity.

3. 結果と考察（Results and Discussion）

The presented technique improves the performance of the $CsPbBr_3$ lasers achieving a low threshold $P_{th} < 4$ μJ/cm² for single-mode lasing. The precise control of the dimensions permits to control the lasing wavelength. The presented lithographic patterning technique offers a strategy for developing perovskite-based laser arrays that could impact integrated optoelectronic circuits.

4. その他・特記事項（Others）

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5. 論文・学会発表（Publication/Presentation）

(1) D. Xing, C.-C. Lin, Y.-L. Ho, A. Syazwan A. Kamal, I.-T. Wang, C.-C. Chen, C.-Y. Wen, C.-W. Chen, J.-J. Delaunay, *Advanced Functional Materials*, **2020**, 2006283.

6. 関連特許（Patent）

なし