

課題番号 : F-21-UT-0009
利用形態 : 機器利用
利用課題名(日本語) :
Program Title (English) : Hexagonal boron nitride as an ideal substrate for carbon nanotube photonics
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キーワード/Keyword : リソグラフィ・露光・描画装置, carbon nanotubes, hexagonal boron nitride

1. 概要(Summary)

In this project, we demonstrate that h-BN serves as an ideal nano-spacer for CNTs to couple with photonic crystals.

2. 実験(Experimental)

【利用した主な装置】

高速大面積電子線描画装置、クリーンドラフト潤沢超純水付、高速シリコン深掘りエッチング装置、ステルスダイサ

【実験方法】

We perform deterministic transfer of a CNT and h-BN by taking into account the spectral shifts of the CNT and the cavity modes in contact with h-BN. The fundamental mode of a test nanobeam (Double-suspended beam structure) cavity is redshifted by 27.6 nm after the transfer of an h-BN flake. Based on the shift amount, we seek a target nanobeam whose cavity mode under this particular h-BN flake would match the (13,5) tube emission on h-BN. We then prepare CNT/h-BN/cavity

heterostructure based on the shifts.

3. 結果と考察(Results and Discussion)

A PL spectrum of the CNT in Figure 1 has a cavity-coupled narrow line, exhibiting a nearly perfect spectral and spatial matching.

4. その他・特記事項(Others)

Collaborators: Takashi Taniguchi, Kenji Watanabe, Kosuke Nagashio. Work supported in part by JSPS (KAKENHI JP19K23593, JP16H05962, JP19H00755), and MIC (SCOPE 191503001). Growth of hexagonal boron nitride crystals supported by the MEXT Element Strategy Initiative to Form Core Research Center, Grant Number JPMXP0112101001 and JST (CREST JPMJCR15F3). K. O. is supported by JSPS Research Fellowship. We acknowledge the Advanced Manufacturing Support Team at RIKEN and T. Nishimura for technical assistance.

5. 論文・学会発表(Publication/Presentation)

[1] K. Otsuka, N. Fang, D. Yamashita, T. Taniguchi, K. Watanabe, and Kato, Y. K. "Deterministic transfer of optical-quality carbon nanotubes for atomically defined technology". Nature communications, 12(1), 1-8, 2021.

6. 関連特許(Patent)

なし

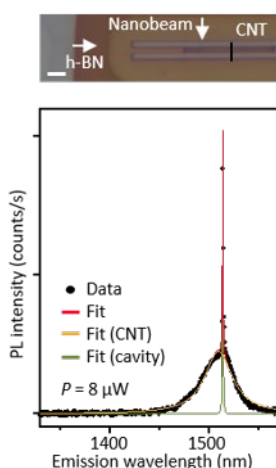


Figure 1. (Top) Optical micrograph of a nanobeam cavity with h-BN above. Scale bar is 2 μm . (Bottom) PL spectrum of the cavity-coupled CNT on h-BN.