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利用形態 : 機器利用
利用課題名(日本語) :
Program Title (English) : Morphology control of single-walled carbon nanotubes
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キーワード/Keyword : single-walled carbon nanotubes, morphology control, property, リソグラフィ・露光・描画装置

1. 概要(Summary)

Single-walled carbon nanotubes (SWNTs) have been regarded as one of the most promising materials in the future advanced applications. However, their performance in devices is highly dependent on their assembling properties which will be determined by their micro morphology. This proposal aims at solving the inconsistency between the transparency and the conductivity through a control of microstructure of SWNT forest with a simple stamping method.

2. 実験(Experimental methods)

【利用した主な装置】; 高速大面積電子線描画装置, 光リソグラフィ装置 MA-6

【実験方法】

The pattern mask is designed and prepared by e-beam lithography. A further photolithography process is conducted on a flat template substrate with the prepared mask in Takeda cleanroom. SWNT forests are grown by alcohol catalytic chemical vapor deposition (ACCVD) with dipcoated CoMo catalyst on Si/SiO₂ substrate [1]. Template patterns are then transferred to the SWNT forest by a simple stamping method and a water vapor treatment process will make the compacted SWNT films more conductive and transparent.

3. 結果と考察(Results and Discussion)

The result is expected to improve the conductivity

and transparency of SWNT films and then promote their applications in devices. Experimental results show that the obtained SWNT films have a better uniformity than the natural honeycomb microstructure [2]. The better uniformity and controllability on the honeycomb structure result in a significant improvement in transparency and conductivity.

This patterned SWNT film is promising in many fields of applications as thin transparent conductive films. Further control of microstructures by the stamping patterns and process endows optimized properties of SWNT films and helps to push forward the industrialization of SWNT films in the devices with low cost and enhanced performance.

4. その他・特記事項(Others)

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[1] S. Maruyama, R. Kojima, Y. Miyauchi, S. Chiashi, M. Kohno, Chem. Phys. Lett. 360, 229 (2002).

[2] K. Cui, T. Chiba, S. Omiya, T. Thurakitseree, P. Zhao, S. Fujii, H. Kataura, E. Einarsson, S. Chiashi, S. Maruyama. J. Phys. Chem. Lett. 4, 2571 (2013).

5. 論文・学会発表(Publication/Presentation)

なし

6. 関連特許(Patent)

なし