

課題番号 : F-20-UT-0055
 利用形態 : 機器利用
 利用課題名(日本語) :
 Program Title (English) : Substrate effects on molecular adsorption onto individual carbon nanotubes
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 キーワード/Keyword : Carbon nanotube, molecular adsorption, time trace, リソグラフィ・露光・描画装置

1. 概要(Summary)

We investigate the role of substrate (with Ti/Pt) on molecular adsorption on to the surface of carbon nanotube using time trace Photoluminescence spectroscopy.

2. 実験(Experimental)

【利用した主な装置】

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

【実験方法】

A single walled carbon nanotube (SWCNT) based field effect transistor (FET) devices are fabricated using Si/SiO₂ (300 nm oxide layer). The deep trenches of 500 nm are fabricated using electron beam lithography (EBL) and dry etching method. To cover trenches with oxide layer, the samples are oxidized in an annealing furnace for 60 minutes at 1050 °C. The metal electrode of Ti/ Pt (2/40 nm) with different widths 25-200 μm at constant gap of 100 μm are deposited using an additional step of EBL and sputtering technique. The third step of EBL is used for designing of the catalyst area. The air suspended carbon nanotubes are grown over the trenches through chemical vapor deposition method at 800 °C for 1min.

The time trace Photoluminescence (PL) of suspended SWCNT FET devices are characterized by home built microspectroscopy system. A continuous-wave Ti:sapphire laser of wavelength 720-1020 nm is used to focus on the sample by objective. The PL is collected through the same objective lens. An InGaAs photodiode array attached to a spectrometer is used to detect the signal from the nanotube.

3. 結果と考察(Results and Discussion)

We have successfully fabricated the SWCNT based FET devices and performed time trace measurements for different nanotubes as shown in Fig. 1 and 2.

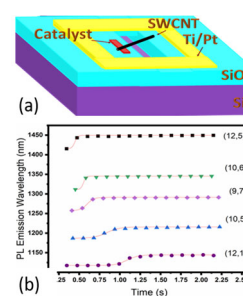


Fig. 1(a) A schematic diagram of CNT based FET devices and (b) time trace plot for different nanotubes.

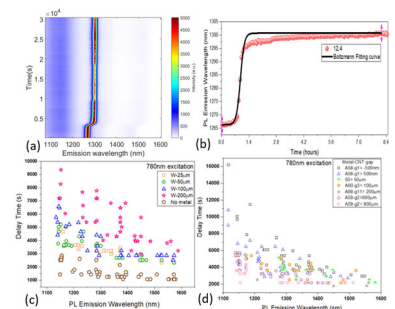


Fig. 2 (a) A time track map of a single nanotube, (b) the corresponding PL wavelength dependent time plot for the same tube. Delay time analysis for the metal, (c) widths and (d) gap to the CNT at 780nm, 200 μW.

We performed time trace and excitation dependent PL measurements for a single air suspended SWCNT. We also investigated the metal width and gap dependent PL time trace measurements for different nanotubes.

4. その他・特記事項(Others)

Alka Sharma is an International JSPS fellow. This work is supported by JSPS (KAKENHI JP16H05962) and MEXT (Nanotechnology Platform)

[1] Alka Sharma, Shunsuke Tanaka, Hidenori Machiya, Akihiro Ishii, and Yuichiro K. Kato, “Molecular screening effects on bandgap renormalization in air-suspended single-walled carbon nanotubes” conference on Fundamental Optical Processes in Semiconductors (FOPS) (August 4-9, 2019), Canada.

5. 論文・学会発表(Publication/Presentation)

None

6. 関連特許(Patent) None