課題番号　　:F-16-FA-0014
利用形態　　:機器利用
Program Title (English)　:Fabrication of single layer graphene nanoribbon field effect transistor and controlling its property
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## 1. 概要(Summary)

The discovery of graphene ignited intense research to explore the electronics property of 2D materials. It opens the wide range of applications in the area of electronics engineering and is good contender to replace the silicon technology in near future. Since the pristine graphene (width > 10nm) is semimetallic, and the zero bandgap graphene device has low on/off ratio which hinders the application of graphene based nano and microelectronic devices. Hence various efforts have been made open the band gap in graphene[1] , but the devices performance is just fairly well due to lack of charge transport and complex structure. The Purpose of present work is to create the band gap in the synthesized semimetallic sGNR.

## 2. 実験(Experimental)

【利用した主な装置】

レーザービーム描画装置、スピンコーター、マスクアライナー、ステッパ、電子顕微鏡、比抵抗測定器

【実験方法】

We have synthesized sGNR by sonication method with very high yield (> 90 %)[2]. Obtained sGNR solution was casted on substrate and then the electrodes were fabricated by electron beam (EB) lithography which bridges the GNR. Drain-source current (Ids) was measured with respect to applied voltage (Vds), which showes semimetallic characteristic of sGNR. Next HAT-CN6 nanoparticles (NPs) which is strong electron acceptor[3] with LUMO energy of -4.4eV was used to alter the property of sGNR. After adsorption of HAT-CN6 on sGNR the current is suppressed due to formation of electron trapping site and I-V curve has been turned semiconducting nature in Fig.1 (a) which confirms that GNR was changed to semiconducting. The phenomenon was caused by formation of bottle neck at sGNR and current pass becomes narrower thus electron transport takes place only through neck of sGNR. Once the sGNR have width < 10 nm it changes to semiconducting nature.

## 3. 結果と考察(Results and Discussion)

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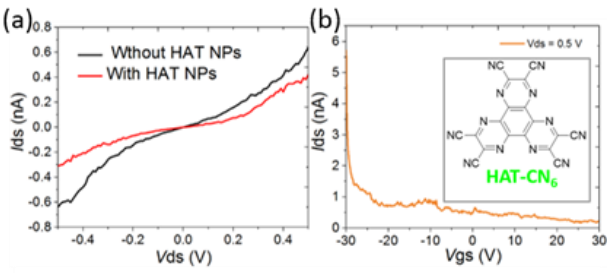


Fig1. (a) I-V characteristic of device without gate effect. (b) I-V characteristic with gate effect showing p-type, NPs structure (inset)

## 4. その他・特記事項(Others)

Refs: [1] Jariwal *et al.*, Jnn. 11, 8 (2011).
[2] H. Tanaka *et al.*, Sci. Rep. 5, 12341 (2015).
[3] G. Aragay *et al.*, J. Am. Chem. Soc. 7, 135 (2013).

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

(1)R. R. Pandey *et al.*, Nanotechnology **2017.**
(2)R. R. Pandey *et al.*, 77th JSAP Niigata, 2016/09/15.

## 6. 関連特許(Patent)

なし。