

課題番号 : F-20-KT-0143
 利用形態 : 機器利用
 利用課題名(日本語) : ナノスケールの振動子の作製とその電気機械特性
 Program Title (English) : Fabrication and electromechanical study of nanoscale resonators
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 キーワード/Keyword : MEMS/ NEMS resonators, graphene, lithography, gas sensing

1. 概要(Summary)

Our objective is to develop nanoscale mechanical resonators of graphene for parts-per-trillion level gas-sensing applications. The primary goal of the experiments is to develop functionalized suspended ribbons of graphene with integrated local gates for capacitive actuation and sensing of resonance vibration. We are particularly interested in developing suspended drum and doubly-clamped resonator devices from chemical vapor deposited (CVD) graphene.

2. 実験(Experimental)

【利用した主な装置】

レーザー直接描画装置, 両面マスクアライナー, 深堀りドライエッチング装置 2, 高速高精度電子ビーム描画装置

【実験方法】

A series of holes (diameter, 1 – 50 μm) are first patterned on SiO_2 / Si wafer and SOI wafer using laser writing, CF_4 etching / DRIE, respectively (Fig. 1). Monolayer CVD graphene is then transferred on this template. Resonance vibration will be induced on the suspended areas using back-gate ac actuation and resonance characteristics will be detected by homodyne optical interferometric measurement for measuring vibration characteristics and estimating Q-factor.

Ultimately, for gas-sensing applications, it is necessary to detect the vibration of graphene resonators by electrical means. However, due to low capacitive coupling with local gate or for unidentified problems arising from device fabrication, our previous attempts at capacitive

sensing met with some challenges. To overcome these challenges, we have developed a set of standard Si resonators with local gate structure, where we have visually confirmed the resonance vibration under a microscope (Fig. 2). Using these standard samples, we are currently optimizing our capacitive sensing set up for vibration detection of graphene resonators.

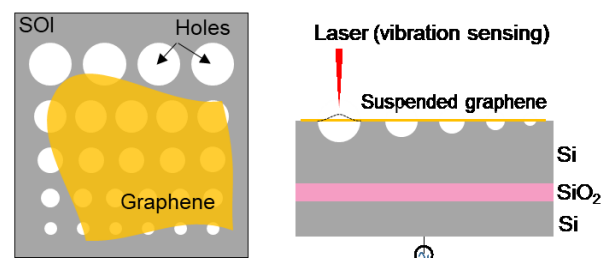


Fig. 1 Schematic diagram of fabrication and vibration sensing of suspended graphene drums.

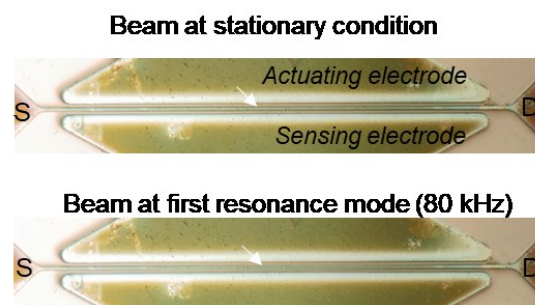


Fig. 2 A Si electromechanical device with a doubly clamped beam at stationary condition and undergoing vibration in first resonance mode.

4. その他・特記事項 (Others)

なし。

5. 論文・学会発表 (Publication/Presentation)

なし。

6. 関連特許 (Patent)

なし。