

課題番号 : F-17-UT-0004  
 利用形態 : 機器利用  
 利用課題名(日本語) :  
 Program Title (English) : Thermal conductivity measurement of single-walled carbon nanotubes by suspended micro thermometer  
 利用者名(日本語) : フェン ヤ<sup>1)</sup>, 丸山茂夫<sup>1),2)</sup>  
 Username (English) : Ya FENG<sup>1)</sup>, Shigeo MARUYAMA<sup>1),2)</sup>  
 所属名(日本語) : 1)東京大学大学院工学系研究科; 2)産業技術総合研究所エネルギーナノ工学研究ラボ  
 Affiliation (English) : 1)Graduate School of Engineering, The University of Tokyo; 2)Energy NanoEngineering Lab., AIST  
 キーワード/Keyword : carbon nanotubes, thermal property, リソグラフィ・露光・描画装置, 膜加工・エッチング

## 1. 概要(Summary)

The thermal conductivity of single walled carbon nanotube has been an intriguing topic since the theoretical prediction of the extraordinary high value due to its quasi-one-dimensional structure. Particularly, the bundle size effect of the thermal conductivity has long been observed, while no experiment has been conducted concerning to the quantitative dependency. To measure the thermal conductivity of single single-walled carbon nanotube, the microdevice (by MEMS) specifically for this purpose have to be fabricated and then transfer the horizontally aligned carbon nanotube onto it for thermal property investigation.

## 2. 実験(Experimental)

### 【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、汎用 ICP エッチング装置、シリコン深掘りエッチング装置

### 【実験方法】

400 nm wide serpentine Pt coil used for thermometer is realized by E-Beam lithography (ADVANTEST F5112+VD01) to pattern the resist for following Ti/Pt electrodes deposition. A second E-Beam lithography comes to pattern the later suspended silicon nitride features. Subsequently, the unwanted silicon nitride is etched away with CHF gas by ULVAC CE-300I. Next, a backside photolithography with Suss MA6 is conducted to

pattern the window for the final release of the silicon nitride pad, then a Si deep etching process by SPTS MUC-21 ASE-Pegasus 4 is followed. Finally, the sample is immersed in KOH to etch the remaining silicon and release the silicon nitride pads. After the microdevice is ready, single-walled carbon nanotube will be transferred onto it with PMMA for the ultimate thermal conductivity measurements.

## 3. 結果と考察(Results and Discussion)

The desired microdevice for nanoscale heat transfer measurement have been achieved, shown in Fig.1 is the Microscope image of it.

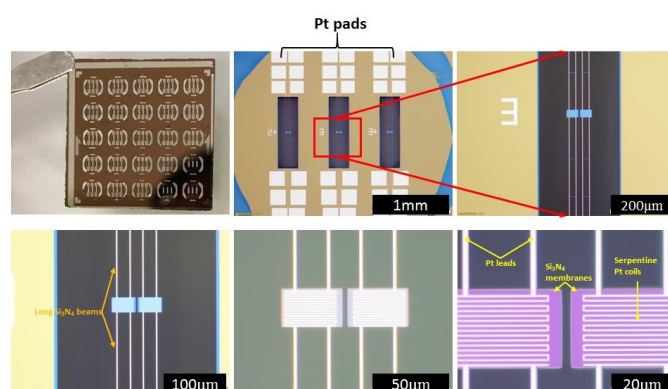


Fig.1 Microscope image of the microdevice for nanoscale thermal investigation.

## 4. その他・特記事項(Others)

Part of this work was financially supported by JSPS KAKENHI Grant-in-Aid for Scientific Research.

## 5. 論文・学会発表(Publication/Presentation) None

## 6. 関連特許(Patent) None