

マテリアル先端リサーチインフラ利用報告書

ARIM User's Report

[Release : 2024.07.25] [Update : 2024.05.21]

課題データ / Project Data

課題番号 Project Issue Number	23UT1186
利用課題名 Title	ヘテロナノ材料の創成とデバイス応用
利用した実施機関 Support Institute	東京大学 / Tokyo Univ.
機関外・機関内の利用 External or Internal Use	内部利用 (ARIM事業参画者以外) / Internal Use (by non ARIM members)
横断技術領域 Cross-Technology Area	加工・デバイスプロセス/Nanofabrication 計測・分析/Advanced Characterization
重要技術領域 Important Technology Area	次世代ナノスケールマテリアル/Next-generation nanoscale materials 高度なデバイス機能の発現を可能とするマテリアル/Materials allowing high-level device functions to be performed
キーワード Keywords	リソグラフィ / Lithography, 光リソグラフィ / Photolithography, 膜加工・エッチング / Film processing/etching, 電子分光 / Electron spectroscopy, ナノチューブ / Nanotube, 高周波デバイス / High frequency device, 高品質プロセス材料/技術 / High quality process materials/technique, センサ / Sensor, エレクトロデバイス / Electronic device, 光デバイス / Optical Device, 先端半導体 (超高集積回路) / Advanced Semiconductor (Very Large Scale Integration)

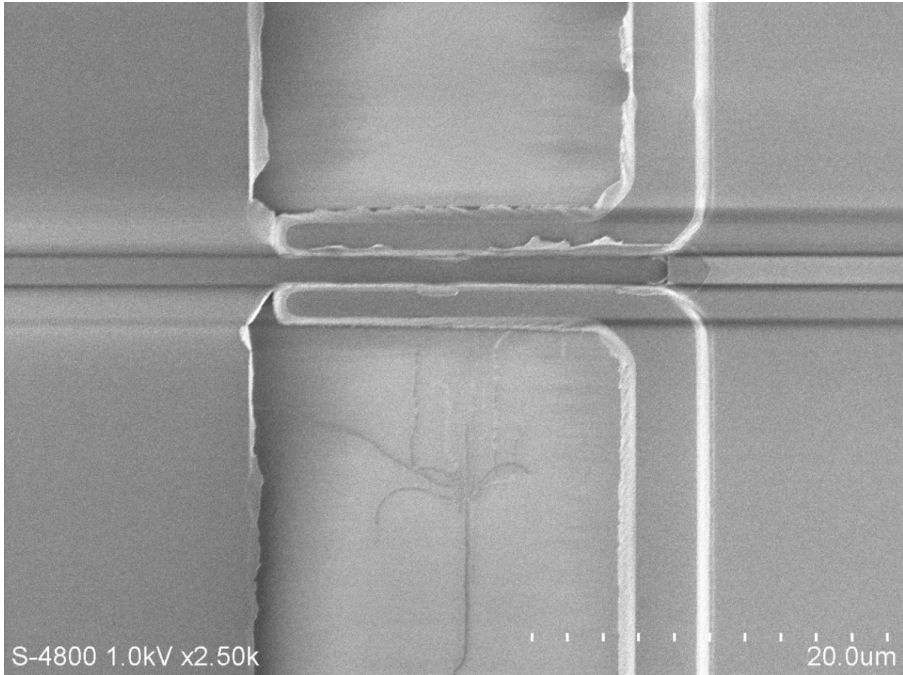
利用者と利用形態 / User and Support Type

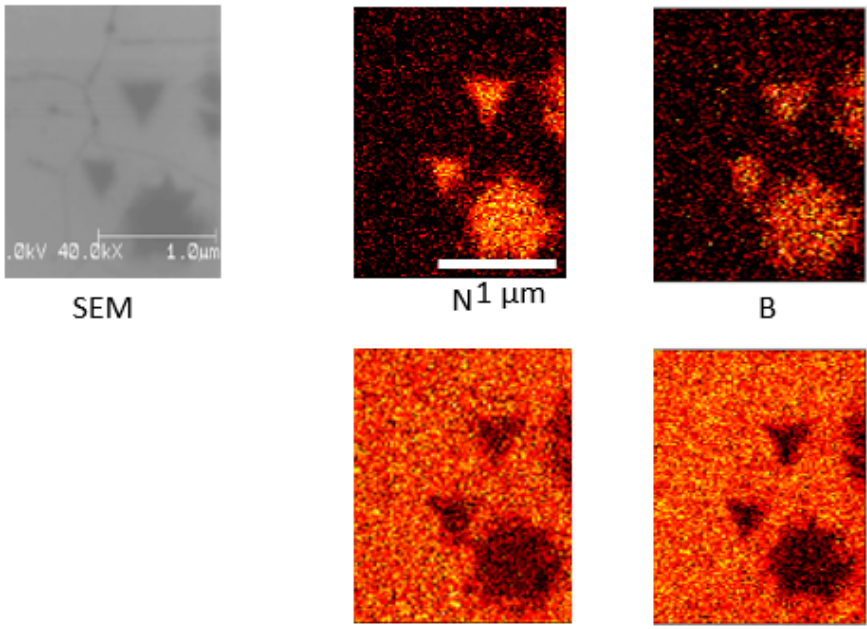
利用者名 (課題申請者) User Name (Project Applicant)	千足 昇平
所属名 Affiliation	東京大学工学部機械工学科
共同利用者氏名 Names of Collaborators in Other Institutes Than Hub and Spoke Institutes	Weijie JIA, Waka Miyata, Hodaka Nishimura
ARIM実施機関支援担当者 Names of Collaborators in The Hub and Spoke Institutes	
利用形態 Support Type	機器利用/Equipment Utilization

利用した主な設備 / Equipment Used in This Project

利用した主な設備 Equipment ID & Name	UT-505 : レーザー直接描画装置 DWL66+2018 UT-600 : 汎用ICPエッチング装置 UT-609 : XeF2ドライエッチングシステム UT-504 : 光リソグラフィ装置MA-6 UT-854 : オージェ分光分析装置
---	---

報告書データ / Report

概要（目的・用途・実施内容） Abstract (Aim, Use Applications and Contents)	<p>This study aims to enhance the controlled synthesis of low-dimensional materials—specifically carbon (CNT), boron nitride (BNNT), and hexagonal boron nitride (h-BN)—through chemical vapor deposition (CVD) techniques. The unique feature lies in their ability to be combined via Van der Waals force, resulting in hetero structures, materials that exhibit novel properties. The objective is to investigate applications in electronics, sensors, and emerging technologies, capitalizing on the distinctive characteristics of these synthesized materials. Specifically, the research involves the direct synthesis of h-BN on CNT or surfaces to achieve a super-clean interface without contamination introduced during transfer processes. This heterostructure is then utilized in field-effect transistors (FET) and other applications.</p>
実験 Experimental	<p>The heterostructure is synthesized via CVD and characterized using SEM, TEM, AES, and Raman spectroscopy. Following characterization, field-effect transistors (FETs) are fabricated using photolithography, ALD, sputtering, thermal evaporation, and RIE techniques. Electronic measurements are subsequently conducted to assess the performance of the fabricated devices.</p>
結果と考察 Results and Discussion	<p>The fabrication of a field-effect transistor (FET) based on a CNT and h-heterostructure has been successfully achieved (Figure a). However, the ON current appears to be impacted by the strong interaction between CNT and quartz substrates. Additionally, the synthesis of h- on has been successful, as shown in Figure b, though there is potential for further enhancement in yield.</p>
図・表・数式 1 Figures, Tables and Equations 1	 <p style="text-align: center;">Figure a. SEM of fabricated CNT FET</p>

<p>図・表・数式 2 Figures, Tables and Equations 2</p>	 <p>SEM</p> <p>N 1 μm</p> <p>B</p> <p>C</p> <p>O</p> <p>Figure b. SEM and AES of grown h-BN on graphene</p>
<p>その他・特記事項 (参考 文献・謝辞等) Remarks(References and Acknowledgements)</p>	

成果発表・成果利用 / Publication and Patents

<p>DOI (論文・プロシーディング) DOI (Publication and Proceedings)</p>	
<p>口頭発表、ポスター発表 および、その他の論文[1] Oral Presentations etc.</p>	<p>2023.05.25 *西村 帆貴, 日下部 健太, 金田 遼太郎, 大塚 慶吾, 井ノ上 泰輝, 丸山 茂夫, 千足 昇平, (D121) "無触媒CVDによるグラフェン・h-BN構造制御合成." 第60回日本伝熱シンポジウム (福岡国際会議場, 福岡), oral</p>
<p>口頭発表、ポスター発表 および、その他の論文[2] Oral Presentations etc.</p>	<p>2023.09.04 *Y. Shimada, S. Nishida, T. Endo, R. Kaneda, H. Nishimura, K. Otsuka, S. Maruyama, S. Chiashi, (1-3) "Surfactant-free fabrication of CNT transparent conductive films on the liquid layer interface. " The 65th Fullerenes-Nanotubes-Graphene General Symposium (FNTG) (Kyushu University, Fukuoka, Japan), oral</p>
<p>特許出願件数 Number of Patent Applications</p>	<p>0件</p>
<p>特許登録件数 Number of Registered Patents</p>	<p>0件</p>