

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 : 2025.06.10] [Update : 2025.03.18]

課題データ / Project Data

課題番号 Project Issue Number	24WS0461
利用課題名 Title	ナノスケールTFLNデバイスの製造
利用した実施機関 Support Institute	早稲田大学 / Waseda Univ.
機関外・機関内の利用 External or Internal Use	外部利用/External Use
ARIM半導体基盤PF 関連課題 Related to ARIM-SETI	指定なし / No Designation
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	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	Thin Film Lithium Niobate (TFLN), Nanoscale, 蒸着・成膜 / Vapor deposition/film formation, リソグラフィ / Lithography, 光リソグラフィ / Photolithgraphy, 電子線リソグラフィ / EB lithography, 膜加工・エッチング / Film processing/etching, 電子顕微鏡 / Electronic microscope, 光導波路 / Optical waveguide, フォトニクスデバイス / Nanophotonics device, 光デバイス / Optical Device

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)	Heinsalu Siim
所属名 Affiliation	産業技術総合研究所
共同利用者氏名 Names of Collaborators Excluding Supporters in the Hub and Spoke Institutes	
ARIM実施機関支援担当者 Names of Supporters 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

<p>利用した主な設備 Equipment ID & Name</p>	<p>WS-003 : 電子ビーム蒸着装置 WS-012 : 電界放出型 走査電子顕微鏡 WS-007 : ICP-RIE装置 WS-015 : 電子ビーム描画装置 WS-016 : レーザー直接描画装置</p>
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報告書データ / Report

<p>概要 (目的・用途・実施内容) Abstract (Aim, Use Applications and Contents)</p>	<p>In this project, the equipment available at the Research Organisation for Nano & Life Innovation (NTRC) will be used to achieve the initial objectives of the project. The main objective is to verify the feasibility of fabrication and to establish at least a rough recipe for the fabrication. With each step of fabrication to be optimised to reach a sufficient level so that the final device could be comparable, if not better, of Thin Film Lithium Niobate (TFLN) devices reported in the literature.</p>
<p>実験 Experimental</p>	<p>UV lithography with (AZ resists with Maskless Exposure (WS-016)) is utilized for initial microscale fabrication with dry etching (ICP-RIE (WS-007)). EB lithography (ARP resist with EBL Exposure (WS-015)) is utilized for more finer nanoscale pattern and EB Vapor Deposition (WS-003) to create the metal based hard masks. SEM (WS-012) and Stylus Profiler (WS-021) equipment are utilized for characterization.</p>
<p>結果と考察 Results and Discussion</p>	<p>Firstly, it was confirmed that true microscale pattern fabrication using lithium niobate (LiNbO_3) as the WG for the optical devices was feasible using the equipment available at NTRC. Secondly, regarding the device fabrication itself. The main problems should be mentioned first. The fabrication is more difficult than using the standard Si or SiO_2 materials with the main problems being sidewall roughness and low sidewall angles. The first test devices fabricated in UV lithography showed rather low sidewall angles. By switching to EB lithography, it was observed that a non-conductive layer was required and that the sidewall angle showed some improvement. In order to obtain even higher values, a metal-based mask was considered at the cost of slightly rougher sidewalls compared to the previous mask consideration. In order to improve the sidewall roughness, it was also confirmed that post-cleaning works to some extent. To achieve the the target sidewall angle values and smooth sidewalls, the dry etch conditions, the metal mask preparation and the post-cleaning have to be carefully optimised. *At the current stage no public results were presented/published.*</p>
<p>図・表・数式 Figures, Tables and Equations</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>	
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口頭発表、ポスター発表 および、その他の論文 Oral Presentations etc.	
特許出願件数 Number of Patent Applications	0件
特許登録件数 Number of Registered Patents	0件