

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 : 2025.05.13]

課題データ / Project Data

課題番号 Project Issue Number	24OS0016
利用課題名 Title	レーザー粉末床溶融結合法による SUS316L の微細組織解析
利用した実施機関 Support Institute	大阪大学 / Univ. of Osaka
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	計測・分析/Advanced Characterization
重要技術領域 Important Technology Area	マルチマテリアル化技術・次世代高分子マテリアル/Multi-material technologies / Next-generation high-molecular materials マテリアルの高度循環のための技術/Advanced materials recycling technologies
キーワード Keywords	電子顕微鏡/ Electronic microscope,3D積層技術/ 3D lamination technology

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)	孫 飛
所属名 Affiliation	名古屋大学 工学研究科
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	技術補助/Technical Assistance,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	OS-003 : 200kV原子分解能走査透過分析電子顕微鏡 OS-005 : 複合ビーム3次元加工・観察装置 OS-012 : 200kV回折コントラスト電子顕微鏡
---------------------------------	---

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>Laser powder bed fusion (LPBF) is currently the most versatile metal additive manufacturing (MAM) process, enabling the production of complex parts without the design limitations of traditional manufacturing methods. The rapid and repeated thermal cycles create intense thermal gradients, leading to metastable chemical, structural, and mechanical states, resulting in metallurgical defects that compromise material properties. Extensive research of LPBF-processed 316L SS has been conducted to improve the mechanical properties and highlight the need to correlate different microstructural features with the manufacturing process. Most studies have focused on characterizing microstructures from macro to sub-micrometer scales, with few investigating features at the nano or atomic levels. Therefore, this study aims to explore these nano/atomic scale microstructural features to better understand the relationship between solidification microstructure and process parameters.</p>
<p>実験 Experimental</p>	<p>A basic set of process parameters was selected for manufacturing the studied specimens. Microstructural characterization was performed on the as-built specimens without heat treatment. Microstructural features were observed by scanning electron microscopy (SEM, JSM-7001F, JEOL, Tokyo, Japan) and transmission electron microscopy (TEM, JEM-2100PUS, JEM-ARM200F, JEOL Ltd., Tokyo, Japan).</p>
<p>結果と考察 Results and Discussion</p>	<p>A novel method has been successfully proposed to clarify the segregation behavior of melt pool boundary (MPB) by controlling the crystallographic texture of 316L SS through unique LPBF processing parameters to obtain a single-crystal-like microstructure of the cellular structures along the laser scanning direction. The accurate location of the track-track MPB is distinguishable by means of the transverse and longitudinal cellular dislocation structures on both sides. The edge-on state of the track-track MPB makes the quantitative concentration analysis precisely using HAADF-STEM with energy-dispersive X-ray spectroscopy, which is in good agreement with the Scheil-Gulliver solidification simulations</p>
<p>図・表・数式 1 Figures, Tables and Equations 1</p>	<p>Quantitative revealing the solute segregation behavior at melt pool boundary in additively manufactured stainless steel using a novel processing method for precise positioning by HAADF-STEM</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

DOI (論文・プロシーディング) [1] DOI (Publication and Proceedings)	Fei Sun, Quantitative revealing the solute segregation behavior at melt pool boundary in additively manufactured stainless steel using a novel processing method for precise positioning by HAADF-STEM, <i>Materials Characterization</i> , 217 , 114435(2024). DOI: 10.1016/j.matchar.2024.114435
口頭発表、ポスター発表 および、その他の論文[1] Oral Presentations etc.	[1] Fei Sun, Yoshitaka Adachi, Kazuhisa Sato, Takuya Ishimoto, Takayoshi Nakano, Yuichiro Koizumi, Nano-scaled solidification microstructure characteristics in additively manufactured 316L stainless steel, 13th Asia Pacific Microscopy Congress 2025 (APMC13), Brisbane, Australia, 2-7 February 2025.
口頭発表、ポスター発表 および、その他の論文[2] Oral Presentations etc.	[2] Fei Sun, Yoshitaka Adachi, Kazuhisa Sato, Takuya Ishimoto, Takayoshi Nakano, Yuichiro Koizumi, Nano-scaled solidification microstructure characteristics in additively manufactured 316L stainless steel, 34th Annual Meeting of MRS-J, 2024. 12.16-18.
特許出願件数 Number of Patent Applications	0件
特許登録件数 Number of Registered Patents	0件