Mechanics of Advanced Composite Structures 12 (2025), Serial Number 26, 707 – 726

Semnan University

Mechanics of Advanced Composite Structures

Journal homepage: https://macs.semnan.ac.ir/

ISSN: 2423-7043

Review Article

An Overview of Progression and Recent Trends in Additively Manufactured AlSi10Mg Alloy through Scientometrics

Karthikeyan Lakshmanan [a*], Pitchipoo Pandian [b], Rajakarunakaran Sivaprakasam [a], Vignesh Kumar Vijaya Kumar [c]

[a] *Department of Mechanical Engineering, Ramco Institute of Technology, Rajapalayam, 626117, India*

[b] *Department of Mechanical Engineering, PSR Engineering College, Sivakasi, 626140, India*

[c] *Department of Mechanical Engineering, K. Ramakrishnan College of Technology, Trichy, 621112, India*

ARTICLE INFO

Article history:

Received: 2024-05-27

Revised: 2025-04-03

Accepted: 2025-05-14

Keywords:

Aluminium alloy;

AlSi10Mg;

Additive manufacturing;

Scientometric analysis.

ABSTRACT

This review presents a scientometric analysis of statistical research publications in the field of additively manufactured AlSi10Mg alloy and provides an extensive stance on research transition for the interested researchers in this field. Many researchers attempted to write review articles with manual work that ended with inadequate expertise to link common areas of the literature in a systematic and sequential manner. At present, most of the researchers' challenges include gathering bibliometric sources with mapping, keyword collections, the author's network, and year-wise progression in research areas. In this review, the Scopus engine was used to locate, gather required information, and statistics for consideration. The keywords AlSi10Mg and additive manufacturing were used in the Scopus search engine while collecting the relevant literature archives for the last ten years from 2014 to 2023. The VOSviewer software tool was used to visualize and create the bibliometric links from 1260 related documents, which contained abstracts, bibliographic citations, and other keywords. The review also summarized the various additive manufacturing processes of AlSi10Mg alloys. This review revealed that the Journal of "Additive Manufacturing" has the highest publication record in the research on additively manufactured AlSi10Mg alloys, with Gu Dongdong being the most productive researcher with 23 articles and 2131 citations. China, Italy, and Germany have the highest publication records. Laser bed fusion is the most preferred additive manufacturing process for producing AlSi10Mg to achieve the desired properties and the facility to apply numerous processing parameters.

1. Introduction

Additive Manufacturing (AM) is a word that signifies technology that makes three-dimensional objects by depositing constituents such as plastics, metals, etc., onto a prototype that is created using computer-aided modeling. Before 1980, we referred to it as "rapid prototyping" and limited its use to the creation of functional prototypes. In recent times, its production has expanded rapidly into key industries such as automobiles, aerospace and medical fields, etc. [1], [2], [3], [4] AM is an industrial version of 3D printing technology that was previously employed in several manufacturing industries to make significant engineering parts. Recently, we can use the terms additive manufacturing and 3-D printing

*** Corresponding author.**
E-mail address: karthikeyan.designresearch@gmail.com

Cite this article as:

Lakshmanan, K., Pandian, P., Sivaprakasam, R. and Vijaya Kumar, V. K., 2025. An Overview of Progression and Recent Trends in Additively Manufactured AlSi10Mg Alloy through Scientometrics. *Mechanics of Advanced Composite Structures*, 12(3), pp. 707-726.
https://doi.org/10.22075/MACS.2025.34263.1681

interchangeably. Though AM has been in the industry for around thirty years, it has only just become very popular and drawn the attention of common people and technical specialists. Attaran et al. [5] stated five key values of AM compared to conventional methods, viz. speed, cost, impact, quality, and innovation/transformation. AM technologies can replace several conventional manufacturing practices with a single-step process, with the approach of the design-to-manufacture concept.

On the other hand, AM processed Titanium and Aluminium alloys are the lightest materials that are currently being investigated by most of the researchers [6]. At present, Al-Si-Mg alloys have high demand for a variety of engineering applications such as motor racing, the automotive sector, aerospace, and heat exchanger components due to superior mechanical capabilities [7]. The AlSi10Mg alloy is comprised of aluminium, silicon, and magnesium, where aluminium offers lightweight properties and good corrosion resistance, Silicon improves machining fluidity and ease of casting, and Magnesium accounts for strength and good mechanical features. AlSi10Mg and Ti6Al4V alloys are typically cast or forged, then machined to achieve the desired final dimensions and shape. Recently, AM technology has replaced traditional manufacturing methods due to the significant material waste, high manufacturing costs, and prolonged manufacturing processes associated with these traditional manufacturing methods [8], [9]. In most of the AM processes, hardenable AlSi10Mg eutectic AlSi12 alloys are used [10]. Most of the cast AlSi10Mg alloys require a post-machining process to achieve a good surface finish and meet exact dimensions. But, in the case of AM processes, additional processing could be ignored, particularly hard-to-machine Aluminium alloys [11]. This review work aims to provide information to young researchers regarding the research progression of additively manufactured AlSi10Mg alloy and its manufacturing techniques. The novelty of this work is that no such review has been reported for additively manufactured AlSi10Mg with scientometric analysis.

This review further provides a comprehensive perspective on research transition by analyzing the latest research documents for future researchers in this field.

Figure 1 represents the year-wise progress of research publications on the AlSi10Mg alloy from 2017 to 2023 as per the Scopus database. The initial publications on the AlSi10Mg alloy were minimal before 2015. Based on these data, there was slow progress in the early 2010s up to 2017 in the publication records, and a maximum publication record of 422 was reported in 2023. After that, there is a notable annual growth rate of 33.30% in both the publication count and the rate of publication from 2018, with 55 publications so far this year (Jan 2023), and it is anticipated to cross more than 600 publications. The COVID scenario may cause the annual publishing improvement rate to appear less than anticipated between 2020 and 2022.

2. Review Technique

Literature reviews are progressively playing a significant role in combining the recent research information to utilize the existing knowledge, provide a platform for the right direction of research, and provide evidence-based insights to formulate research objectives. At present, various qualitative and quantitative methods are used by researchers to organize the literature. Among these, scientometric analysis helps to analyze a large amount of information to predict exact research trends. This review used a scientometric evaluation of the data from the collected literature to assess several elements of publications. A scientometric study uses systematic mapping, an expert-developed technique for analyzing bibliometric data [12], [13].

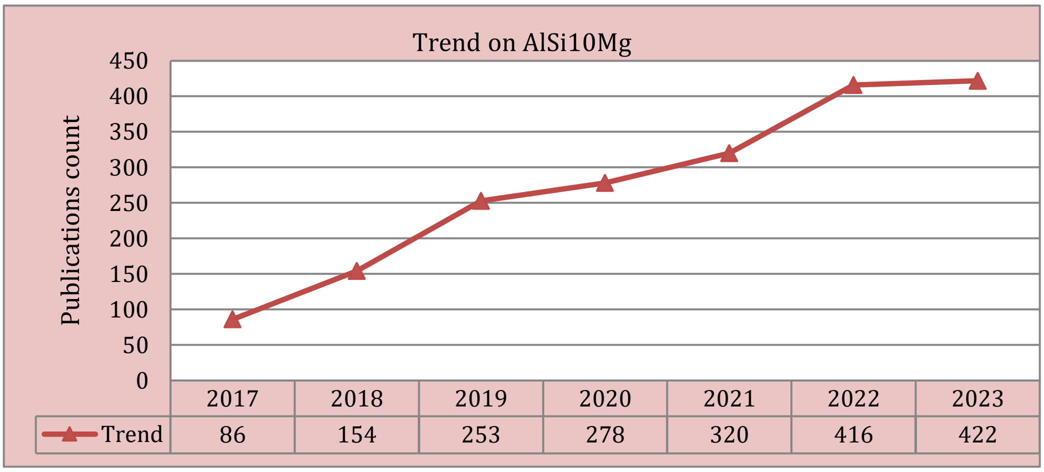

Fig. 1. Publication documents the trend on AlSi10Mg from 2017 to 2023

Most of the researchers recommended the Scopus search engine to gather bibliometric data [14], [15]. The same search engine was used to assess the publications record on the AlSi10Mg alloy for the last ten years from 2014 to 2023. As of 2023, the Scopus search for the keywords "AlSi10Mg and Additive Manufacturing" showed 1260 publication records. Many filter backgrounds were used to decrease undesirable documents. The flow of data extraction, refinement, and restrictions followed during the review is represented in Figure 2. After refining the data collection, finally, 933 documents were kept for further assessments and saved in Comma Separated Values (CSV) format. The VOSviewer open-source mapping software was used to assess the collected data represented scientifically and quantitatively.

Researchers across different fields of study frequently use the VOSviewer open-source mapping tool, and it's highly recommended by many academicians [16]. The present investigation objectives were achieved through VOSviewer capabilities.

After extracting the database from the Scopus search engine (CSV format), files were uploaded into VOSviewer and examined while maintaining the reliability and integrity of the data. During data analysis, the sources of publications, common keywords, authors with the most citations, and published journals, countries with the highest journals were examined and reported. In addition to quantitative data analysis, various additive manufacturing techniques of AlSi10Mg alloy were reported.

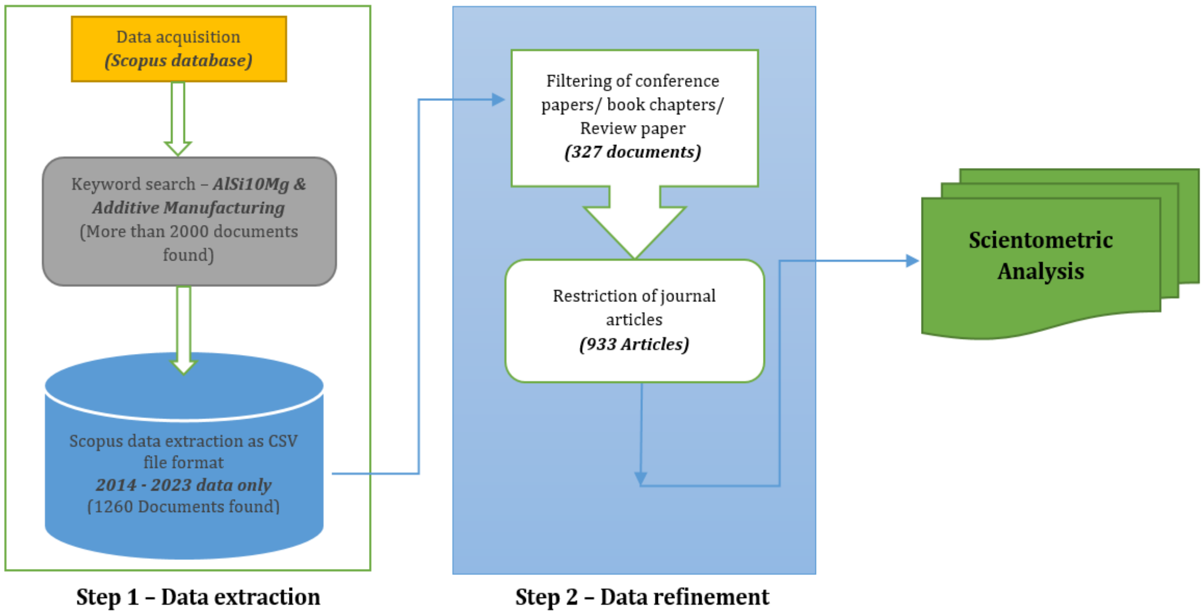

Fig. 2. Data collecting flow from the Scopus database for the last 10 years

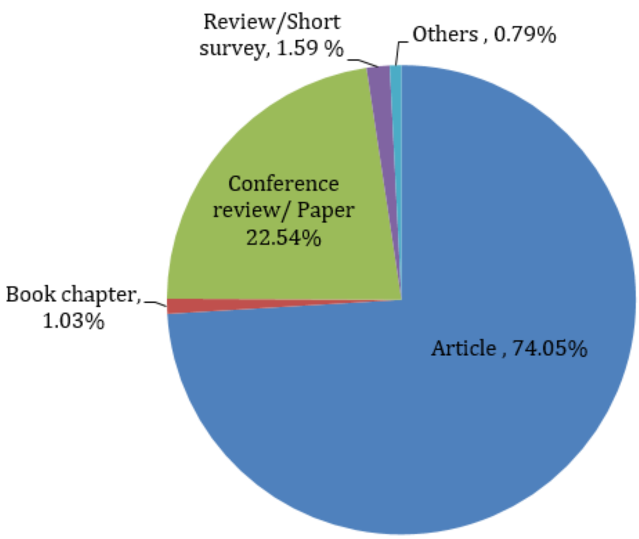

Fig. 3. Publication type on additively manufactured AlSi10Mg

3. Scientometric Analysis

3.1. Research Progression on Additively Manufactured AlSi10Mg

Based on the data collections from the Scopus list, research articles or conference publications account for 74.05% and 22.54%, whereas book chapters, reviews/short surveys & others account for 3.14%, as illustrated in Figure 3. Figure 4 portrays the growth of publication outcomes for the last ten years up to 2023. Up to 2017, there was slow progress in the publication outcomes in the field of additively manufactured AlSi10Mg alloy. After that, the rate of publication outcomes increased gradually, with an average of nearly 30 articles every year up to 2022. The number of articles published in the relevant field continues to rise annually, reaching 208 in the most recent year, 2023.

3.2. Sources of Publications

Based on the bibliometric statistics, publication outcomes in the form of journals were assessed by the VOSviewer software. A minimum of ten publication outcomes and citations were fixed as filters, and 21 out of 243 outcomes matched with said requirement. Table 1 shows the journal outcomes containing a minimum of 10 documents with more than 10 citation records on additively manufactured AlSi10Mg from 2014 to 2023. "Additive Manufacturing", "Materials Science and Engineering: A", and "Metals" were exposed to be the top three publication records, based on the number of publication outcomes with 74, 54, and 39 articles. Additionally, based on the citations in the last ten years, the top three records were "Additive Manufacturing," which gained 5194 citations, "Materials science and engineering: A," which gained 4044 and "Materials and design," which gained 2371 citations. Furthermore, publication outcomes based on average citations were measured with the ratio of the number of citations received to the number of documents; the prominent three outcomes were found to be "Journal of materials processing technology", "Materials science and Engineering: A" and "Additive manufacturing" with closely 95, 75 and 70 average citations correspondingly. These statistical data indicate that the majority of scholars follow or cite work from reputable journals. Figure 5. shows sources with ten or more papers published in the last ten years. The frame size in Figure 5a reflects the source's influence on the researched region; a larger frame size denotes a greater influence, based on publication count. It shows "Additive Manufacturing" has a superior frame than the other outcomes, suggesting that publication outcome in the field of "Additively manufactured AlSi10Mg". Four clusters, each with a specific colour (blue, red, yellow, and green) shared in Figure 5a.

The scope of the research source, or how frequently they are co-cited in associated articles and outcomes in relation to the publications' co-citation frequency, is used to create clusters in VOSviewer [17]. Figure 5b. Illustrated, different colours represent wavering densities for publication outcomes. Yellow has the highest density strength, followed by light green and light yellow shades. The yellow color shades "Additive Manufacturing", "Journal of alloys and compounds", "Materials and Design", "Metals & Materials", and other noticeable publications specify outcome contribution to "Additively Manufactured AlSi10Mg alloy".

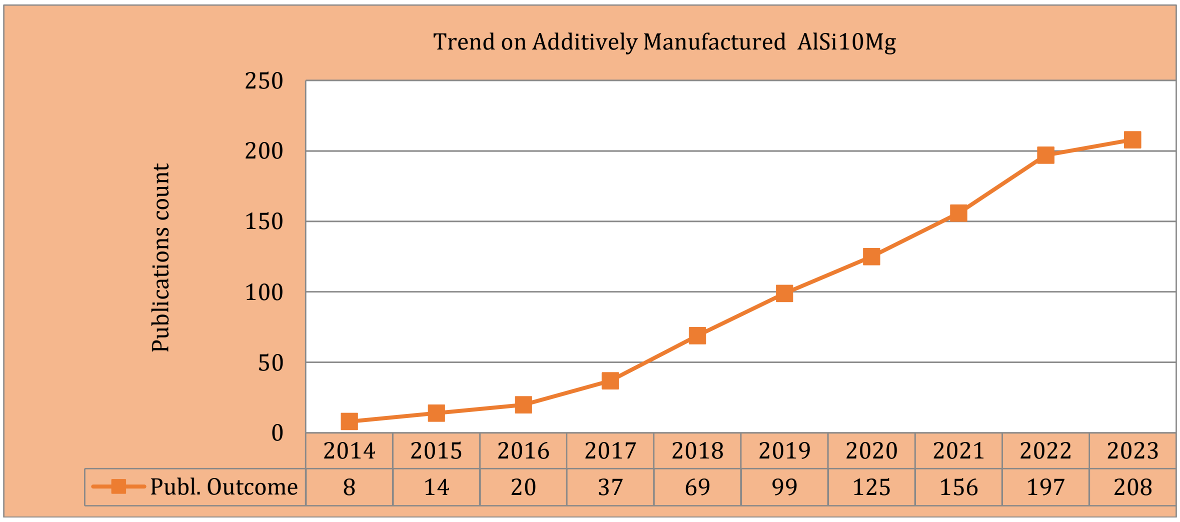

Fig. 4. Publication documents trend on additively manufactured AlSi10Mg – Last ten years

Table 1. List of publication outcomes with a minimum of ten publications on Additively Manufactured AlSi10Mg for the last ten years

Sl. No	Publication outcome	Article publications	Citations gains	Avg. citations
1.	Additive Manufacturing	74	5194	70
2.	Materials Science and Engineering: A	54	4044	75
3.	Metals	39	517	13
4.	Materials	38	821	22
5.	Materials and Design	35	2371	68
6.	International Journal of Fatigue	28	1483	53
7.	International Journal of Advanced Manufacturing Technology	24	463	19
8.	Journal of Alloys and Compounds	22	631	29
9.	Journal of Manufacturing Processes	19	291	15
10.	Progress in Additive Manufacturing	18	138	8
11.	Journal of Materials Processing Technology	16	1515	95
12.	Journal of Materials Research and Technology	16	146	9
13.	Rapid Prototyping Journal	15	135	9
14.	Journal of Materials Engineering and Performance	14	120	9
15.	Materials Characterization	13	670	52
16.	Journal of Laser Applications	12	434	36
17.	Advanced Engineering Materials	11	154	14
18.	Jom – Springer	11	308	28
19.	International Journal of Heat and Mass Transfer	10	318	32
20.	Journal of Manufacturing and Materials Processing	10	272	27
21.	Materials Letters	10	229	23

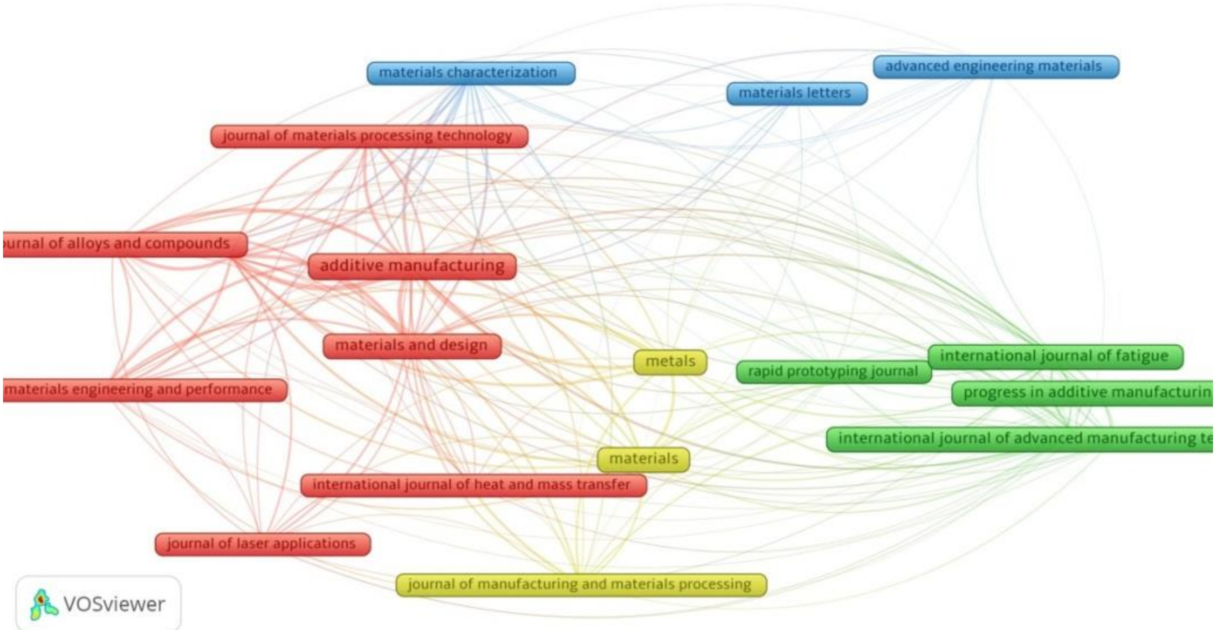

Fig. 5a. Network Mapping of publication outcomes with a minimum of ten articles on additively manufactured AlSi10Mg

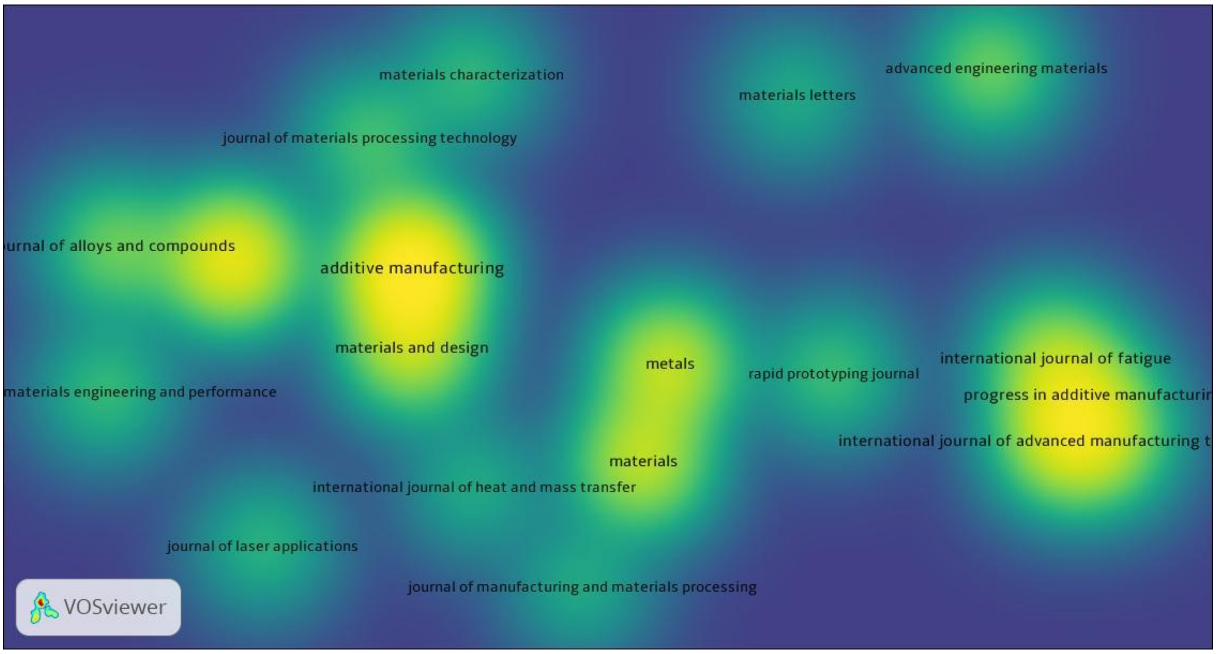

Fig. 5b. Network Mapping of publication outcomes with a minimum of ten articles on additively manufactured AlSi10Mg

3.3. Keywords Mapping

In research, keywords usually play a vital role in highlighting and differentiating the essential field of study [18]. The lowest threshold value for keyword replications was retained at 25; 76 of the 5842 keywords satisfy this threshold value. Table 2 shows the 25 most frequently used keywords in publication outcomes. In the "Additively Manufactured AlSi10Mg alloy, the top five arising keywords are Additive Manufacturing, Additives, 3D printers, Selective laser melting, and AlSi10Mg. Figure 6 displays keyword mapping with co-occurrences, keyword links, and occurrence frequency. The size of the node for keywords in Figure 6 represents its frequency, while the position denotes its co-occurrence in articles that have been published. The way displayed clusters are highlighted on the map illustrates how frequently they appear in various article publications. Terms are grouped by color based on how frequently they appear together in articles. The image shows that the most important keywords are those with larger nodes than the rest, suggesting their importance in said research field.

3.4. Authors' Scientific Mapping

Imported publication citations into carefully chosen bibliometric and other tools used for quantitative analysis and visualization. Citations indicate a researcher's importance in a certain field of research [19]. The minimum article threshold value for an individual author and citations count is kept as 10 & 100, respectively. Table 3 lists the authors based on an analysis of bibliometric data, who have the greatest publications and citations in said research field. The number of citations divided by the total number of documents was used to determine the average number of citations for a particular author. When all factors, including the quantity of publications, average citations, and total citations, are taken into account, it might be challenging to assess a researcher's effectiveness. Based on data analysis, Gu, Dongdong is the supreme productive researcher with 23 articles, followed by Calignano, Flaviana & Manfredi, Diego with 16 articles. With respect to citations, Gu, Dongdong – 2131, Beretta, S. – 1352 & Mohammadi, Mohsen – 1134 lead the top positions in the research field. Figure 7 symbolizes the relationship of productive authors with a minimum of ten articles.

3.5. Documents Scientific Mapping

The number of citations in an article determines its prominence in a particular academic topic. Articles that receive the most citations in their respective academic domains are considered remarkable. The minimum citation threshold value for an article was set at 100; 63 out of 933 articles met this condition. Table 4 presents the top 10 articles in a specific research field, along with the author details and their respective citation counts. The article titled "3D printing of high-strength aluminium alloys" has acquired 1818 citations, "Reducing porosity in AlSi10Mg parts processed by selective laser melting," has acquired 1084 citations, and "Mechanical behavior of additive manufactured, powder-bed laser-fused materials" has acquired 723 citations, respectively, and stand in the top three positions among 933 articles.

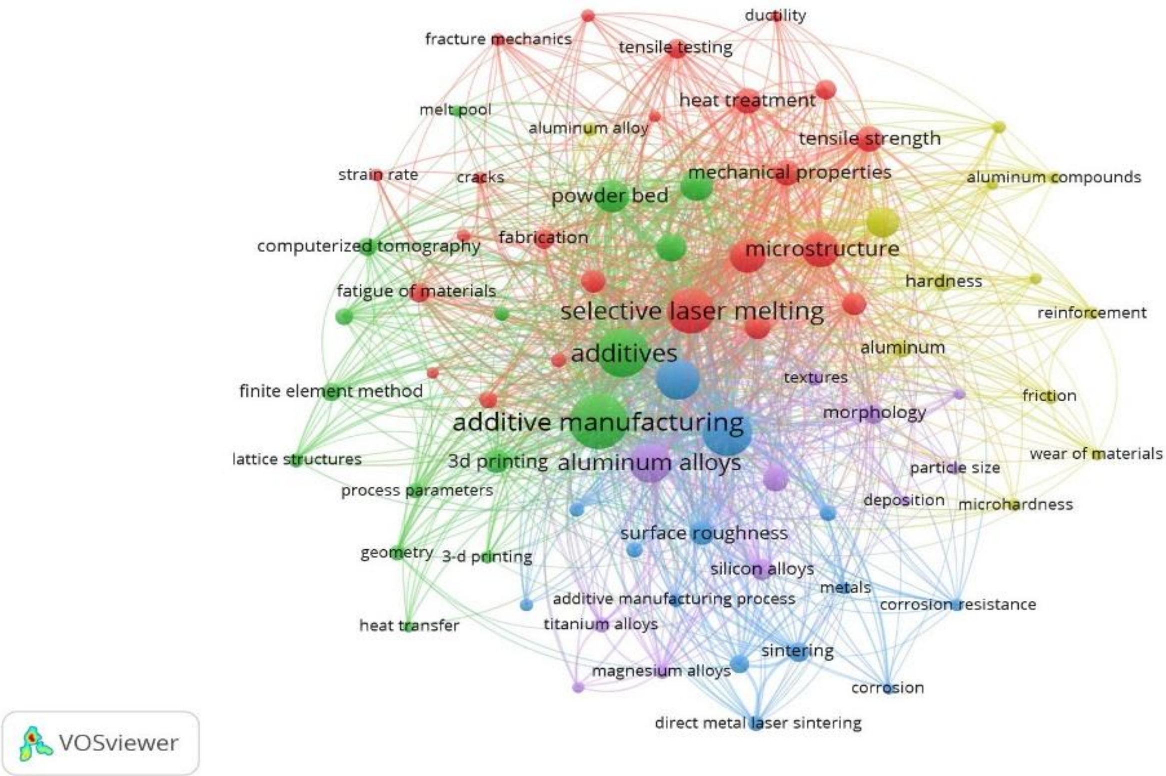

Fig. 6. Scientific keywords mapping

Table 2. List of top 25 mostly used keywords in "Additively Manufactured AlSi10Mg alloy" research

Sl. No.	Keyword	Occurrences
1.	Additive manufacturing	527
2.	Additives	435
3.	3d printers	380
4.	Selective laser melting	352
5.	Alsi10mg	284
6.	Aluminum alloys	282
7.	Microstructure	213
8.	Melting	206
9.	Powder bed	190
10.	Laser powders	176
11.	Silicon	165
12.	Laser powder bed fusion	142
13.	Mechanical properties	121
14.	Tensile strength	114
15.	Heat treatment	111
16.	3d printing	107
17.	Surface roughness	105
18.	Powder metals	102
19.	Selective Laser Melting (SLM)	102
20.	Porosity	96
21.	Scanning electron microscopy	92
22.	Silicon alloys	82
23.	Fatigue of materials	72
24.	Morphology	72
25.	Sintering	72

Table 3. List of the top fifteen authors in the research field in the last ten years

Sl. No	Author Name	Articles	Citations	Avg. citations
1.	Gu, Dongdong	23	2131	93
2.	Calignano, Flaviana	16	418	26
3.	Manfredi, Diego	16	464	29
4.	Mohammadi, Mohsen	14	1134	81
5.	Stern, A.	14	429	31
6.	Beretta, S.	13	1352	104
7.	Takata, Naoki	11	721	66
8.	Bagherifard, Sara	10	335	34
9.	Dai, Donghua	10	986	99
10.	Guagliano, Mario	10	335	34
11.	Kobashi, Makoto	10	717	72
12.	Pola, Annalisa	10	359	36
13.	Rosenthal, I.	10	399	40
14.	Suzuki, Asuka	10	717	72
15.	Tocci, Marialaura	10	359	36

Table 4. List of the top ten articles in the research field in the last ten years

Sl. No.	Article title	Year	Citations	Ref.
1.	3D printing of high-strength aluminium alloys	2017	1818	[20]
2.	Reducing porosity in AlSi10Mg parts processed by selective laser melting	2014	1084	[21]
3.	Mechanical behavior of additive-manufactured, powder-bed laser-fused materials	2016	723	[22]
4.	Parametric analysis of thermal behavior during selective laser melting additive manufacturing of aluminum alloy powder	2014	585	[23]
5.	Selective laser melting of nano-TiB2-decorated AlSi10Mg alloy with high fracture strength and ductility	2017	548	[24]
6.	The microstructure and mechanical properties of selectively laser melted AlSi10Mg: The effect of a conventional T6-like heat treatment	2016	471	[25]
7.	A comparison of fatigue strength sensitivity to defects for materials manufactured by AM or traditional processes	2017	402	[26]
8.	Change in microstructure of selectively laser melted AlSi10Mg alloy with heat treatments	2017	383	[27]
9.	Fatigue properties of AlSi10Mg obtained by additive manufacturing: Defect-based modelling and prediction of fatigue strength	2018	318	[28]
10.	Processing AlSi10Mg by selective laser melting: Parameter optimization and material characterization	2015	317	[29]

Table 5. Top countries with at least 10 publications in the research field

Sl.No.	Country name	Articles published	Citations	Avg. citations
1.	China	203	7394	36
2.	Italy	148	4469	30
3.	Germany	119	2346	20
4.	United States	119	5640	47
5.	India	72	788	11
6.	United Kingdom	68	4447	65
7.	Canada	60	2767	46
8.	Israel	36	1820	51
9.	Japan	36	1106	31
10.	Australia	30	1210	40
11.	France	29	1108	38
12.	Turkey	27	298	11
13.	Singapore	22	692	31
14.	Belgium	21	1793	85
15.	Czech Republic	18	259	14
16.	South Korea	16	108	7
17.	South Africa	14	418	30
18.	Spain	14	324	23
19.	United Arab Emirates	14	246	18
20.	Norway	13	421	32
21.	Poland	12	115	10
22.	Austria	11	179	16
23.	Sweden	11	188	17
24.	Netherlands	10	1009	101

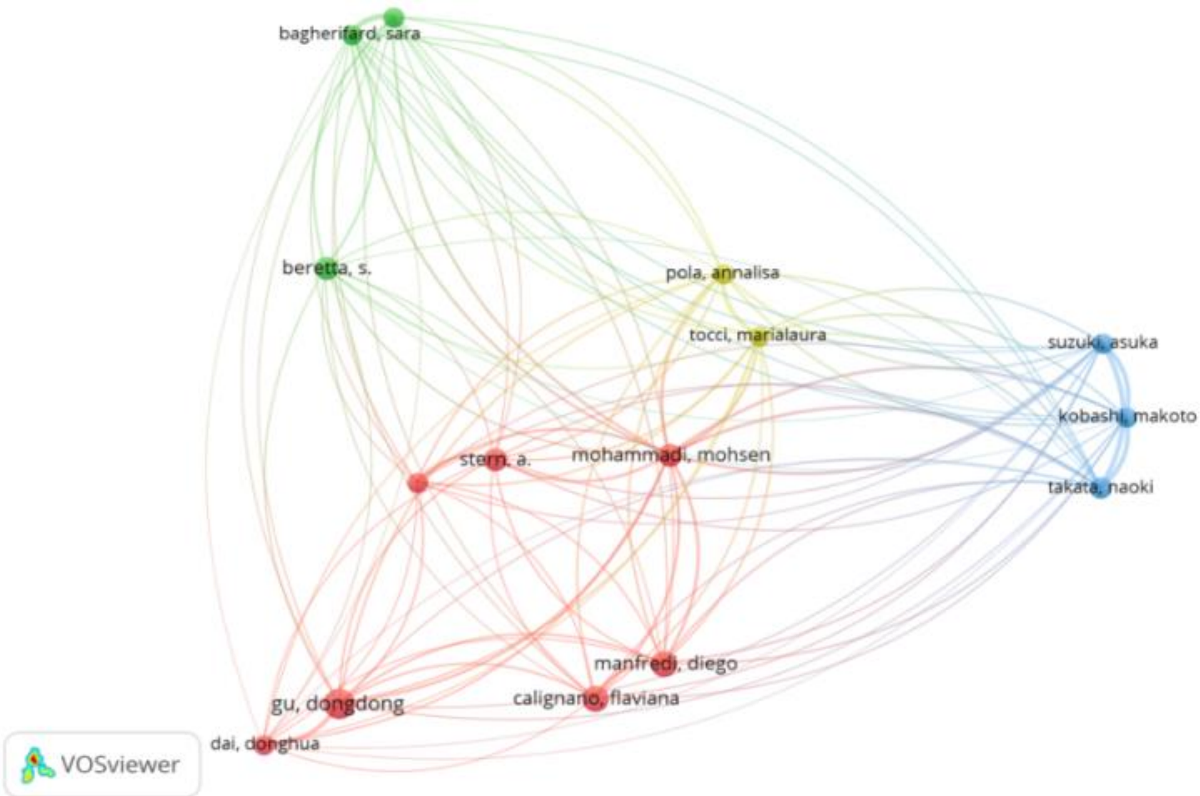

Fig. 7. Author's scientific collaboration with a minimum of 10 publications

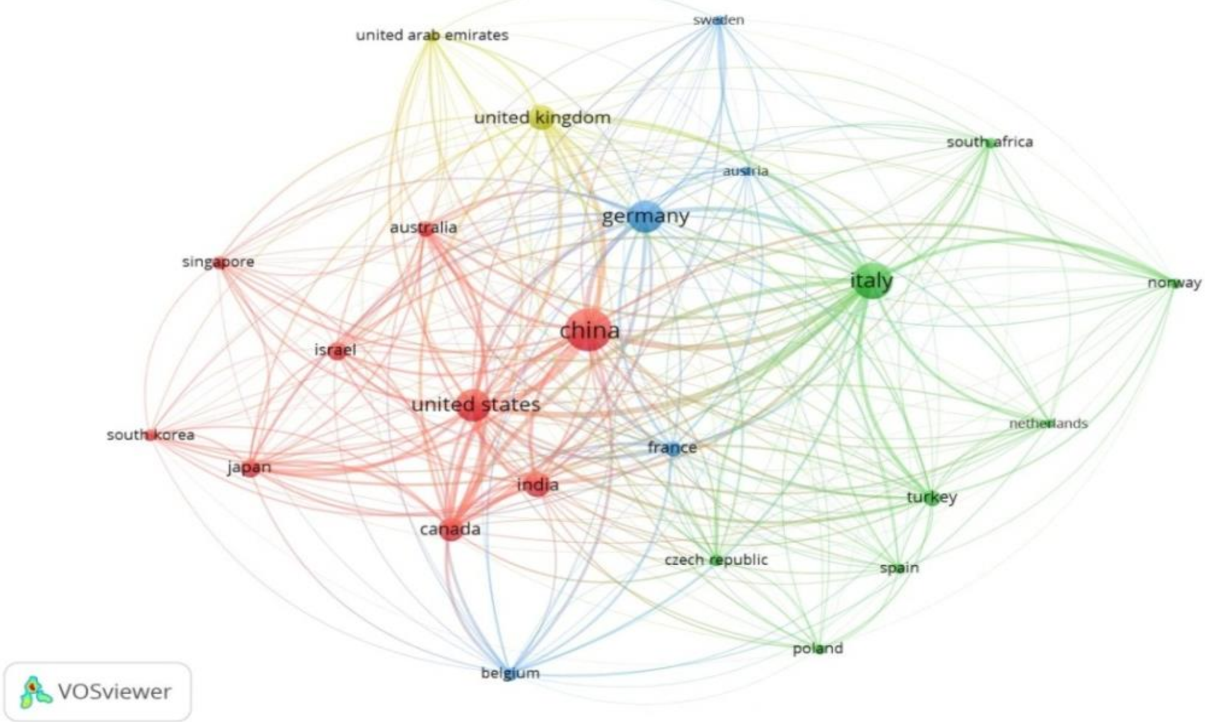

Fig. 8. Scientific visualization of countries mapping over the last ten years

3.6. Country-wise Scientific Mapping

More research sources in the research field have come from certain regions than others, and they plan to continue doing so. The scientific graph was created to allow users to explore areas dedicated to additively manufactured AlSi10Mg alloy-based research. The details of the top nations that contributed to said research field are listed in Table 5. The threshold value was fixed at least 10 articles for selecting top regions. 24 out of 52 countries met the threshold condition for said research field. China, Italy, and Germany published the maximum articles, with 203, 148, and 119 articles, respectively. These countries were recognized with a strong research ecosystem and significant investments in additive manufacturing infrastructure. The Chinese government has emphasized additive manufacturing within its "Made in China 2025" initiative. Italy, Germany, the United States, and India appeared to have a strong small and medium-scale enterprises ecosystem, with 3D printing aligned with the aerospace and automotive sectors. Besides, the countries with maximum citations were found to be China acquired 7394 citations, the United States acquired 5640 citations, and Italy acquired 4469 citations. The average citations, country-wise, were calculated based on citations received with respect to articles published. The average citations leading countries were the Netherlands with 101, Belgium with 85, and the United Kingdom placed in the top three positions. The high average citation count may be linked to the associations of notable authors from these countries. Figure 8 represents country-wise scientific mapping with respect to citations acquired. The node size is directly proportional to country country-wise impact on a research field based on the number of articles in the last ten years. This may be useful for young researchers in said research field to start scientific relationships, establish collaborations, and exchange research outcomes.

4. Additive Manufacturing Techniques of AlSi10Mg alloy

Modern manufacturing is taking the attention of Additive Manufacturing (AM) as a revolutionary production technique. It can produce components at a small buy-to-fly ratio with significantly improved dimensional accuracy [30]. Using the right computerized 3-D model [31], the AM process uses a layer-by-layer deposition method to make a part. The AM process additionally offers numerous added benefits such as reduced manufacturing time, minimized inventory, reduced transport charges, manufacturing waste reduction, and flexibility to satisfy customer requirements [32]. AM techniques are generally categorized as Powder Bed Fusion (PBF) [33], Sheet Lamination (SL) [34], Binder Jetting (BJ) [35], and Direct Energy Deposition (DED)[36] as shown in Figure 9. PBF employs a beam of laser or electron to melt layers of fine metal particles that are firmly filled and uniformly distributed [37]. In PBF category, SLS method uses a laser power source to sinter fine polymer powders to create three dimensional structures [38] SLM method uses high-density laser power to soften and fuse fine metal powders [39] DMLS uses a laser beam to partially melt the fine powder particles [40] Similar to SLM, EBM employs an electron beam as an energy source to melt the powder with a powder bed setup at higher temperature conditions in a vacuum atmosphere [41].

In the SL process, layers of material are fed from a continuous roll and cut using a laser; the layers are then adhered to create the product using heat-activated resin [42]. The BJ process employs liquefied binders and dispenses them to the powder layer to create 3D components [43], [44]. The DED method works with a laser, electric arc or electron beam source to melt the material that comes out of the nozzle [45] WAAM utilizes the filler wire which is melted and deposited using an arc welding heat source [46] The only difference between WLAM and WAAM is the use of a laser beam source in place of arc welding [47] In the EBF method, a metal wire is melted in a vacuum using an electron beam to create 3D parts [48]. Table 6 depicts a few prior research works on additively manufactured AlSi10Mg and its significance. The different additive manufacturing techniques for AlSi10Mg alloy offer an enormous benefit over conventional manufacturing techniques. These advanced manufacturing techniques offer high design freedom, weight reduction, improved performance, quick fabrication, and process customization for automotive and aerospace applications.

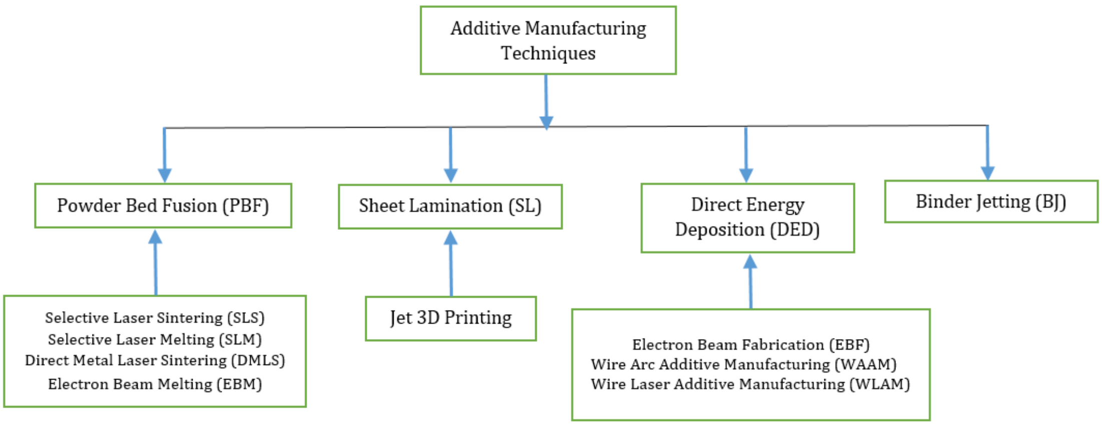

Fig. 9. Categories of additive manufacturing techniques

Table 6. A few previous works by various authors on additively manufactured AlSi10Mg and its significance

Authors	AM Technique	Parameters	DOE/Methodology	Remarks
Vadapally Rama Rao et al. [49]	SLM	Laser power source – 370 W, Scan Speed 1300mm/s, Hatch spacing 0.19mm & Layer thickness 0.03mm	10 mm height and 15 mm diameter cylindrical samples prepared and solutionised at 520 °C for 2 h and then quenched in water - Hot impression test performed for both as-built and solution-treated samples, Microstructural analysis, XRD	As-built AlSi10Mg alloy exhibited superior indentation resistance than heat-treated samples. The as-built samples exhibited a higher level of hardness compared to the heat-treated samples.
Jozef Šutka et al. [50]	SLM	Laser power source – 200 W, layer thickness 25 µm, Wall thickness 2 mm	Granulometry ranging from 20 to 30µm, recycled AlSi10Mg alloy powder was used. Hardness, Static tensile test, Microstructural analysis performed	Due to enhanced oxidation during sample manufacturing caused by the oxide coating on powder grains, the recycled powder's tensile strength and elongation values were lower than the material sheet data.
Chongjun Wu et al. [51]	SLM	Laser power source – 400W, Speed 200mm/s, layer thickness 50µm, operating temperature was 1200 °C	Mathematical modeling for heat conduction, FEM was investigated	The article discussed the essentials of the heat treatment process during SLM for producing high-performance samples.

Authors	AM Technique	Parameters	DOE/Methodology	Remarks
P. Ashwath et al. [52]	SLM	Laser power source – 100W, Spot diameter – 60 µm,	Microstructural, relative density, Hardness, and Tensile tests were performed	SLM processed samples (cooling rate at 500 mm/s) showed improved hardness, tensile strength, along with good microstructural / Strength integrity compared to non-processed casted AlSi10Mg samples
Liubov Magerramova et al. [53]	SLM	Laser power source – 138 - 152W, Speed 950-1050mm/s, step - 82µm	Energy thermal calculation, SLM simulation process & Metallographic Analysis were performed	A 15% reduction in the original mass was made possible by the modification of the 3D model of the housing construction, constructed of aluminum alloy. Results indicated that 97% of the powder particles are spherical and range in size from 15 to 45µm.
Yeong Seong Eom et al. [54]	SLM	Laser power 350–390 W, Speed 2800 mm/s Cube shaped samples	Mechanical properties (Strength & elongation) & Microstructural properties were studied	Extremely flowable AlSi10Mg powder was successfully synthesized by the gas atomization process. The study exhibited mechanical properties that were comparable to previous studies, while the laser power was kept at 360W
C. Gao et al. [55]	SLM	Laser power – 200W, Speed – 1200mm/s, hatching distance – 0.09mm	Vickers hardness, tensile test, & Morphological and microstructural characterization were studied	TiN/AlSi10Mg composite parts exhibit tensile strength of 492MPa, Ductility of 7.5 %, and micro hardness of 156 HV, which is higher than other studies ' SLM-based AlSi10Mg, Al-Cu-Zn composites
Naor Elad Uzan et al. [56]	SLM	Laser power – 370 W, Speed – 1000mm/s, hatching distance – 0.2mm, laser spot size - 80µm	Creep tests (With and without current) were studied, and macrostructural & microstructural analyses were performed.	Electric current enlarged the specimen's sensitivity to applied stress. Microstructure (SEM/TEM) studies exposed that continuous Si-rich cellular boundaries were damaged and separated sub-micron Si particles were formed, causing a high stress exponent value.
Wolfgang Schneller et al. [57]	SLM	Laser power – 400 W, beam diameter - 100µm, Isostatic pressing followed by quenching process	Fatigue tests were performed for with and without hot isostatic pressing (HIP) treated samples, Fracture Surface Analysis & Microstructure studies were also conducted.	An advantageous effect on fatigue strength of HIP-treated samples was observed. A significant reduction in porosity by 64% was achieved.
Avi Leon et al. [58]	SLM	Laser power – 400 W, Speed – 1000mm/s, spot size 80 µm, hatch spacing 0.2 mm	The effect of surface roughness, corrosion performance, & Microstructure was studied.	The corrosion resistance of unpolished SLM-produced AlSi10Mg was lower than polished AlSi10Mg samples.
K. Tahmasbi et al. [59]	SLM	Laser power – 350W, Speed – 1800mm/s, hatch spacing - 90 µm, layer thickness – 30 µm	LB-PBF AlSi10Mg parts printed in the vertical direction with five unique geometries to run ultrasonic fatigue (20 kHz) and tensile tests.	The lowest porosity and the highest fatigue resistance were observed in the specimens that were machined from large rods and slabs.
M.Avateffazeli *et al.* [60]	SLM	Laser power- 350 W, 1000–2000 mm/s scan speed, 80µm laser spot size, 0.05–0.10 mm hatch distance, 50 µm layer thickness	Microstructure and mechanical properties, including work hardening rates of AM Al-Cu-Mg-Ag-TiB2 (A205) & AlSi10Mg, followed by T7, T6 heat treatments, were investigated	T6 aging doesn't necessarily improve the mechanical properties of the as-printed AlSi10Mg alloy. For improved mechanical properties, printing and post-stress relief heat treatment may work without T6 heat treatment.
S. I. Shakil *et al.* [61]	SLM	Laser power of 200 W, spot size of 70 µm, ytterbium-doped fiber laser is used	Indentation creep properties of Additively manufactured and Cast AlSi10Mg alloy were compared	The as-built LPBF sample exhibits minimal creep deformation, while the cast-AC state of the cast samples shows the lowest creep displacement.
S. I. Shakil *et al.* [62]	SLM	The cast and AM parts were solutionized at 540°C for 2 hours, followed by water quenching, air cooling, and furnace cooling.	The impact of different heat treatments on the microstructure and micromechanical properties of cast and SLM AlSi10Mg was studied.	Cooling cycles significantly influence the morphology of eutectic silicon in both cast and additive-manufactured materials, affecting microstructural evolution and local micromechanical properties.

Authors	AM Technique	Parameters	DOE/Methodology	Remarks
F. Alghamdi *et al.* [63]	SLM	Post-fabrication heat treatment on SLM printed samples, including solution treatment - 520°C for 1 hour	The small-scale mechanical properties of the as-printed and heat-treated materials, including depth-sensing indentation experiments, were studied	Post-thermal treatments can alter the microstructure, texture, and micromechanical properties of the SLM AlSi10Mg alloy.
F. Alghamdi et al. [64]	SLM	AlSi10Mg (cubes of 1 cm^3), With two 400-watt lasers,	As-printed samples were used for T6 heat treatment, which includes solutionizing at 520°C for 1 hour, water quenching, and artificial ageing at 170°C for 4 hours.	T6 artificial ageing of AM AlSi10Mg resulted in a 42% decrease in strength upon heat treatment. The indentation size effect increased hardness with depth reduction, but was less pronounced in heat-treated materials.
Vijaykumar S. et al. [65]	SLM	Laser power – 370W, Scan Speed – 1300mm/s, Layer thickness - 30 µm, Hatch Spacing – 0.19mm	Experimented using L9 orthogonal array with three-level, three-factorial Taguchi design considering temperature, sliding velocity, and load	The dry sliding wear test on prints revealed higher wear loss at elevated temperatures and higher loads. Machine learning techniques were employed to investigate the correlation between input variables and wear rate.
Erfan Maleki et al. [66]	SLM	Laser power – 350W, Scan Speed – 1150mm/s, Layer thickness - 50 µm, Hatch Spacing – 170 µm	Conducted extensive experimental tests on surface texture, microstructural characterizations, porosity measurements, hardness, residual stresses, monotonic tensile tests, and rotating bending fatigue tests at four stress levels.	Post-treatments improved surface texture, eliminating anomalies. ML-based modeling showed pre-trained deep neural networks outperformed other networks in predicting fatigue life, achieving over 99% accuracy.
P. Fathi et al. [67]	DMLS	Laser power – 400 W, spot size 100µm, Layer thickness - 30 µm	Microstructure & Electrochemical properties of 3 groups of AlSi10Mg (Improved surface quality) were studied	The hatch distance relation with sample surface quality was reported. Corrosion behavior and morphology performance improvements are also reported
Biagio Palumbo et al. [68]	DMLS	Laser power – 400W, spot size 100µm, Scan speed: up to 7m/s	A statistical method was used to evaluate the effects of various laser exposure approaches on the achievable tensile characteristics of AlSi10Mg components	Good mechanical properties were achieved, and higher build rates were identified. A laser source of 400W achieved a larger build rate than lower sources, ranging from 100 to 250W
M. Ghasri-Khouzani [69]	DMLS	Laser power – 280W, Speed – 2m/s, hatch space - 60 µm, layer thickness - 30 µm	Measurements of micro hardness and microstructural analysis were carried out on several planes of the AlSi10Mg alloy disk.	Investigations revealed that the AlSi10Mg alloy produced by DMLS had an average micro-hardness that was around 24% higher than the die-cast alloy.
Carter Baxter et al. [70]	DMLS	Laser power – 370W, Spot size - 100 µm, Speed – 1.3m/s, hatch space of 190 µm	Stress-strain flow curves, hardening variations & mechanical properties were investigated.	Cylindrical shape AlSi10Mg_200C printed with horizontal and vertical directions, subjected to shock loading conditions. Strain rate behavior was compared.
Amir Hadadzadeh et al. [71]	DMLS	Laser power – 370W, Speed – 1.3m/s, hatch distance – 190 µm, powder layer - 30 µm	High strain rate (Dynamic impact loading) compressive deformation and morphology of samples (EBSD, SEM, and TEM) were investigated.	Building directions resulted development of Si precipitates with different characteristics. Alloy printed in both directions leads to comparable strength.
Massimo Lorusso et al. [72]	DMLS	Laser power - 200 W and a minimum spot size of 100µm, Powder size is 25µm	Porosity, hardness, Dry sliding wear behavior, & Morphological characterization were investigated	AM manufactured Coefficient of friction (COF) is higher than conventional casted alloy and exhibits good results
Man fredi et al. [73]	DMLS	Laser power - 120 W, speed 900 mm/s, hatch distance - 0.1 mm, Layer thickness - 30µm	Specimens built with various orientations, Mechanical and Microstructural properties were investigated.	Prepared samples contain less porosity, Higher yield strength of approximately 43% was also achieved. An extremely fine cellular dendritic structure is found through microstructure analysis.

Authors	AM Technique	Parameters	DOE/Methodology	Remarks
Vineesh Vishnu et al. [74]	DMLS	Laser power - 370W, speed 1300 mm/s, hatch distance - 0.19 mm, Layer thickness – 0.03mm	The study involved hard anodizing in a sulfuric acid bath, heat treatment, and tribological tests using a high-frequency linear reciprocating tribometer under applied loads of 5 N and 10 N.	Study emphasizes the importance of post-treatment selection for improving the wear resistance and durability of DMLS components for industrial use.
Manjunath Prasad et al. [75]	DMLS	Laser power - 240W, speed 1180 mm/s, hatch distance - 0.12 mm, Layer thickness – 60μm	Tensile, compression, and impact tests were conducted on samples fabricated in two orientations. Fracture analysis was performed on fractured specimens resulting from tensile and impact tests.	XY (45^{o}) orientation has a higher value of tensile strength. The tensile strength of T6 heat-treated samples decreased by 30.2%. T6 heat treatment does not significantly influence the mechanical characteristics of alloy specimens.
Huakang Bian et al. [76]	EBM	Beam accelerating voltage - 60 kV, Current - 4–7 mA, layer thickness 85 μm	Microstructural, hardness, density, and tensile strength were investigated and provide the foundation for Al-based alloy through EBM.	The microstructure of the Al-Si alloy generated by EBM differs from SLM-fabricated and cast counterparts. The Microstructure imparted greater ductility, 25.9 –32.7 %, and overall studies demonstrated strengthening of heat treatment.
Flaviana Calignano et al. [77]	EBM	Laser power – 190-195 W, speed – 800-900mm/s, Hatch distance – 0.10mm, Layer thickness - 30μm	Shot blasting processes on AlSi10Mg and Ti6Al4V parts produced by laser-PBF (L-PBF) and electron beam-PBF (EB-PBF) were performed. Surface roughness was investigated.	The treated surface has a higher roughness value compared to the as-built samples, R_a ranges from a minimum of 5% for the Ta3 to a maximum of about 23% for the Ta4 samples. The effect of glass and zirconia microspheres on surface roughness was also studied.

Every manufacturing technique has its merits and limitations, and the selection depends on intended applications. From the literature, it is evident that SLM is the most common additive manufacturing technique used for AlSi10Mg alloy. Next to SLM, DMLS is also the most popular way to make AlSi10Mg alloy because it uses a laser to selectively melt metal powder in a way that is similar to SLM.

5. Challenges and Opportunities

In automotive and aerospace applications, the additively manufactured AlSi10Mg alloy has proven to be a promising replacement for traditional materials. However, certain challenges exist in the development and research of additively manufactured AlSi10Mg alloy. The said challenges must be overcome to intensify the usage of AlSi10Mg alloy in engineering applications.

1. The proper selection of reinforcement, solidification processing technique, and process parameters for obtaining better properties with minimal residual stresses and distortions.
2. The layer-by-layer deposition technique in the AM process may have an impact on the surface roughness of printed parts, which requires additional post-processing treatments.
3. The Hybrid additive manufacturing process can be used to develop AlSi10Mg alloy, aiming for defect-free and high-strength alloys.
4. Very few researchers attempted, and less attention was given to the optimization of heating and cooling rate, temperature, and their influences on desired mechanical properties.
5. The selection of important printing parameters such as laser power, scan speed, and layer thickness has a greater influence on the microstructure and mechanical properties of AlSi10Mg alloy. To improve the outcomes, different attempts can be made to optimize these parameters.
6. An attempt should be made to study the temperature-dependent properties of the AlSi10Mg alloy, which is essential for selecting a suitable alloy for the design of engineering components.

6. Future Potential Trends

Additionally, the manufactured AlSi10Mg alloy has a wide scope in high-performance applications, which can further benefit from advanced, data-driven attempts to optimize its characteristics and manufacturing techniques. This can be achieved, especially through the integration of Artificial Intelligence (AI) and Machine Learning (ML) techniques.

- Optimize process parameters such as laser power, hatching distance, scan speed, and layer thickness
- Develop simulation tools to infer microstructural changes during printing and after the post-processing stage
- Optimize material usage and energy consumed by machines, aiming for sustainable manufacturing
- Real-time process parameters control to achieve a defect-free product and minimize post-processing time.
- Achieve high-performance AlSi10Mg-based aluminium alloys using data-driven materials design models.

7. Summary and Concluding Remarks

This review objective was to execute a scientometric analysis–based review of archived data on additively manufactured AlSi10Mg alloy research works to evaluate its essential outcomes and trends in the last ten years. The Scopus search engine found 1260 relevant research articles in the field from 2014 to 2023, These data were analyzed by the application of VOSviewer (Version 1.6.18), an open software. Finally, the notable conclusions are as follows:

- Research articles statistics on additive manufacturing of AlSi10Mg alloys reveal that the journals of “Additive Manufacturing”, “Materials Science and Engineering: A”, and “Metals” stand in the top three publications records with 74, 54, and 39 articles, respectively. The top three citations are "Additive Manufacturing" with 5194, "Materials science and engineering: A" with 4044, and "Materials and design" with 2371 citations. Gu, Dongdong, is the supreme productive researcher with 23 articles & 2131 citations, followed by Calignano, Flaviana, and Manfredi, Diego, with 16 articles. China, Italy, and Germany are the leading countries with the most citations. Analysis of keywords - scientific mapping in the research field revealed that Additive Manufacturing, Additives, and 3D printers are mostly used as indexing keywords with maximum records.
- Most of the researchers opted for laser bed fusion in the production of AlSi10Mg alloy due to its ability to achieve desired properties, customize complex geometry, be lightweight, and allow for the application of numerous processing parameters and heat treatments.
- Review evident that only minimum work has been done on additive manufactured AlSi10Mg alloy when compared to research on other alloys in the last ten years. There are prospective research gaps in defect formation mechanisms, fatigue, process optimization, heat treatment effects, and microstructure control mechanisms that still need to be investigated.

8. Limitations of Scientometric Review

Despite remarkable efforts and effective use of VOSviewer software, this scientometric approach stands out with some limitations. This review relies on quantitative metrics with simple numerical indicators and may lack significant qualitative, in-depth research outcomes. It also lacks the ability to encompass research conducted in different languages and regions. Finally, we focused only on the Scopus database, other researchers can attempt it with other databases, such as PubMed and Web of Science, or combinations of other keywords.

Acknowledgments

The authors gratefully acknowledge the support provided by Ramco Institute of Technology, Rajapalayam, Tamil Nadu, India.

Funding Statement

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Conflicts of Interest

The author declares that there is no conflict of interest regarding the publication of this article.

References

[1] Schwarzer, E., Holtzhausen, S., Scheithauer, U., Ortmann, C., Oberbach, T., Moritz, T. and Michaelis, A., 2019. Process development for additive manufacturing of functionally graded alumina toughened zirconia components intended for medical implant application. *Journal of the European Ceramic Society*, 39(2–3), pp. 522–530. doi: 10.1016/j.jeurceramsoc.2018.09.003.

[2] Saltzman, D., Bichnevicius, M., Lynch, S.,

Simpson, T.W., Reutzel, E.W., Dickman, C. and Martukanitz, R., 2018. Design and evaluation of an additively manufactured aircraft heat exchanger. *Applied Thermal Engineering*, 138, pp. 254–263. doi: 10.1016/j.applthermaleng.2018.04.032.

[3] Bogue, R., 2013. 3D printing: The dawn of a new era in manufacturing. *Assembly Automation*, 33(4), pp. 307–311. doi: 10.1108/AA-06-2013-055.

[4] Kleer, R. and Piller, F.T., 2019. Local manufacturing and structural shifts in competition: Market dynamics of additive manufacturing. *International Journal of Production Economics*, 216, pp. 23–34. doi: 10.1016/j.ijpe.2019.04.019.

[5] Attaran, M., 2017. The rise of 3-D printing: The advantages of additive manufacturing over traditional manufacturing. *Business Horizons*, 60(5), pp. 677–688. doi: 10.1016/j.bushor.2017.05.011.

[6] Thijs, L., Kempen, K., Kruth, J.P. and Van Humbeeck, J., 2013. Fine-structured aluminium products with controllable texture by selective laser melting of pre-alloyed AlSi10Mg powder. *Acta Materialia*, 61(5), pp. 1809–1819. doi: 10.1016/j.actamat.2012.11.052.

[7] Alexopoulos, N.D. and Pantelakis, S.G., 2004. Quality evaluation of A357 cast aluminum alloy specimens subjected to different artificial aging treatment. *Materials & Design*, 25(5), pp. 419–430. doi: 10.1016/j.matdes.2003.11.007.

[8] Huang, R., Riddle, M., Graziano, D., Warren, J., Das, S., Nimbalkar, S., Cresko, J. and Masanet, E., 2016. Energy and emissions saving potential of additive manufacturing: the case of lightweight aircraft components. *Journal of Cleaner Production*, 135, pp. 1559–1570. doi: 10.1016/j.jclepro.2015.04.109.

[9] Duda, T. and Raghavan, L.V., 2018. 3D metal printing technology: the need to re-invent design practice. *AI & SOCIETY*, 33(2), pp. 241–252. doi: 10.1007/s00146-018-0809-9.

[10] Herzog, D., Seyda, V., Wycisk, E. and Emmelmann, C, 2016. Additive manufacturing of metals. *Acta Materialia*, 117, pp. 371–392. doi: 10.1016/j.actamat.2016.07.019.

[11] Aboulkhair, N. T., Simonelli, M., Parry, L., Ashcroft, I., Tuck, C. and Hague, R., 2019. 3D printing of Aluminium alloys: Additive Manufacturing of Aluminium alloys using selective laser melting. *Progress in Materials Science*, 106, pp. 100578. doi: 10.1016/j.pmatsci.2019.100578.

[12] Amin, M.N., Ahmad, W., Khan, K. and Sayed, M.M., 2022. Mapping Research Knowledge on Rice Husk Ash Application in Concrete: A Scientometric Review. *Materials (Basel)*, 15(10) pp. 3431. doi: 10.3390/ma15103431.

[13] Markoulli, M.P., Lee, C. I. S. G., Byington, E. and Felps, W. A., 2017. Mapping Human Resource Management: Reviewing the field and charting future directions. *Human Resource Management Review*, 27(3), pp. 367–396. doi: 10.1016/j.hrmr.2016.10.001.

[14] Lasda Bergman, E. M., 2012. Finding Citations to Social Work Literature: The Relative Benefits of Using Web of Science, Scopus, or Google Scholar. *The Journal of Academic Librarianship*, 8(6), pp. 370–379. doi: 10.1016/j.acalib.2012.08.002.

[15] Meho, L.I., 2019. Using Scopus's CiteScore for assessing the quality of computer science conferences. *Journal of Informetrics*, 13(1), pp. 419–433. doi: 10.1016/j.joi.2019.02.006.

[16] Yang, D., Zhao, J., Ahmad, W., Amin, M.N., Aslam, F., Khan, K. and Ahmad, A., 2022. Potential use of waste eggshells in cement-based materials: A bibliographic analysis and review of the material properties. *Construction and Builing Materials*, 344(4), pp. 128143. doi: 10.1016/j.conbuildmat.2022.128143.

[17] Wuni, I.Y., Shen, G.Q.P. and Osei-Kyei, R., 2019. Scientometric review of global research trends on green buildings in construction journals from 1992 to 2018. *Energy and Buildings*, 190, pp. 69–85. doi: 10.1016/j.enbuild.2019.02.010.

[18] Oraee, M., Hosseini, M. R., Papadonikolaki, E., Palliyaguru, R. and Arashpour, M., 2017. Collaboration in BIM-based construction networks: A bibliometric-qualitative literature review. *International Journal of Project Management*, 35(7), pp. 1288–1301. doi: 10.1016/j.ijproman.2017.07.001.

[19] Yu, F. and Hayes, B., 2018. Applying Data Analytics and Visualization to Assessing the Research Impact of the Cancer Cell Biology (CCB) Program at the University of North Carolina at Chapel Hill. *Journal of eScience Librarianship*, 7(1), pp. e1123. doi: 10.7191/jeslib.2018.1123.

[20] Martin, J.H., Yahata, B.D., Hundley, J. M., Mayer, J. A., Schaedler, T. A. and Pollock, T. M. 2017. 3D printing of high-strength aluminium alloys. *Nature*, 549 (7672), pp. 365–369. doi: 10.1038/nature23894.

[21] Aboulkhair, N. T., Everitt, N. M., Ashcroft, I. and Tuck, C., 2014. Reducing porosity in AlSi10Mg parts processed by selective laser melting. *Additive Manufacturing*, 1–4, pp. 77–86. doi: 10.1016/j.addma.2014.08.001.

[22] Mower, T.M. and Long, M.J., 2016. Mechanical behavior of additive manufactured, powder-bed laser-fused materials. *Materials Science and Engineering: A*, 651, pp. 198–213. doi: 10.1016/j.msea.2015.10.068.

[23] Li, Y. and Gu, D., 2014. Parametric analysis of thermal behavior during selective laser melting additive manufacturing of aluminum alloy powder. *Materials & Design*., 63, pp. 856–867. doi: 10.1016/j.matdes.2014.07.006.

[24] Li, X.P., Ji, G., Chen, Z., Addad, A., Wu, Y., Wang, H.W., Vleugels, J., Van Humbeeck, J. and Kruth, J.P., 2017. Selective laser melting of nano-TiB2 decorated AlSi10Mg alloy with high fracture strength and ductility. *Acta Materialia*, 129, pp. 183–193. doi: 10.1016/j.actamat.2017.02.062.

[25] Aboulkhair, N. T., Maskery, I., Tuck, C., Ashcroft, I. and Everitt, N.M., 2016. The microstructure and mechanical properties of selectively laser melted AlSi10Mg: The effect of a conventional T6-like heat treatment. *Materials Science and Engineering: A*, 667, pp. 139–146. doi: 10.1016/j.msea.2016.04.092.

[26] Beretta, S. and Romano, S., 2017. A comparison of fatigue strength sensitivity to defects for materials manufactured by AM or traditional processes. *International Journal of Fatigue*, 94, pp. 178–191. doi: 10.1016/j.ijfatigue.2016.06.020.

[27] Takata, N., Kodaira, H., Sekizawa, K., Suzuki, A. and Kobashi, M., 2017. Change in microstructure of selectively laser melted AlSi10Mg alloy with heat treatments. *Materials Science and Engineering: A*, 704, pp. 218–228. doi: 10.1016/j.msea.2017.08.029.

[28] Romano, S., Brückner-Foit, A., Brandão, A., Gumpinger, J., Ghidini, T. and S. Beretta., 2018. Fatigue properties of AlSi10Mg obtained by additive manufacturing: Defect-based modelling and prediction of fatigue strength. *Engineering Fracture Mechanics*, 187, pp. 165–189. doi: 10.1016/j.engfracmech.2017.11.002.

[29] Kempen, K., Thijs, L., Van Humbeeck, J. and Kruth, J.P., 2015. Processing AlSi10Mg by selective laser melting: Parameter optimisation and material characterisation. *Materials Science and Technology*, 31, no. 8, pp. 917–923. doi: 10.1179/1743284714Y.0000000702.

[30] Blakey-Milner, B., Gradl, P., Snedden, G., Brooks, M., Pitot, J., Lopez, E., Leary, M., Berto, F. and Du plessis, A., 2021. Metal additive manufacturing in aerospace: A review. *Materials & Design*, 209, pp. 110008. doi: 10.1016/j.matdes.2021.110008.

[31] WANG, Z. and ZHANG, Y., 2021. A Review of Aluminum Alloy Fabricated by Different Processes of Wire Arc Additive Manufacturing. *Materials Science*, 27(1), pp. 18–26. doi: 10.5755/j02.ms.22772.

[32] Attaran, M., 2017. The rise of 3-D printing: The advantages of additive manufacturing over traditional manufacturing. *Buiness Horizons*, 60(5), pp. 677–688. doi: 10.1016/j.bushor.2017.05.011.

[33] Liu.J. and Wen, P., 2022. Metal vaporization and its influence during laser powder bed fusion process. *Materials & Design*, 215, pp. 110505. doi: 10.1016/j.matdes.2022.110505.

[34] Bhatt, P.M., Peralta, M., Bruck, H. A. and Gupta, S. K., 2018. Robot Assisted Additive Manufacturing of Thin Multifunctional Structures. in Volume 1: Additive Manufacturing; Bio and Sustainable Manufacturing, *American Society of Mechanical Engineers*. doi: 10.1115/MSEC2018-6620.

[35] Mostafaei, A., Elliott, A.M., Barnes, J.E., Li, F., Tan, W., Cramer, C.L., Nandwana, P. and Chmielus, M., 2021. Binder jet 3D printing—Process parameters, materials, properties, modeling, and challenges. *Progress in Materials Science*, 119, pp. 100707. doi: 10.1016/j.pmatsci.2020.100707.

[36] Ahn, D.G., 2021. Directed Energy Deposition (DED) Process: State of the Art. *International Journal of Precision Engineering and Manufacturing-Green Technology*, 8(2), pp. 703–742. doi: 10.1007/s40684-020-00302-7.

[37] Soundararajan, B., Sofia, D., Barletta, D. and Poletto, M., 2021. Review on modeling techniques for powder bed fusion processes based on physical principles. *Additive Manufacturing*, 47, pp. 102336. doi: 10.1016/j.addma.2021.102336.

[38] Najmon, J.C., Raeisi, S. and Tovar, A., 2019. Review of additive manufacturing technologies and applications in the aerospace industry. *Additive Manufacturing*

for the Aerospace Industry, Elsevier, pp. 7–31. doi: 10.1016/B978-0-12-814062-8.00002-9.

[39] Song, X., Zhai, W., Huang, R., Fu, J., Fu, M.W. and Li, F., 2022. Metal-Based 3D-Printed Micro Parts and Structures. *Encyclopedia of Materials: Metals and Alloys*, Elsevier, pp. 448–461. doi: 10.1016/B978-0-12-819726-4.00009-0.

[40] Ishfaq, K., Abdullah, M. and Mahmood, M. A., 2021. A state-of-the-art direct metal laser sintering of Ti6Al4V and AlSi10Mg alloys: Surface roughness, tensile strength, fatigue strength and microstructure. *Optics & Laser Technology*, 143, pp. 107366. doi: 10.1016/j.optlastec.2021.107366.

[41] Alojaly, H. M., Hammouda, A. and Benyounis, K. Y., 2023. Review of recent developments on metal matrix composites with particulate reinforcement. Reference Module in Materials Science and Materials Engineering, Elsevier. doi: 10.1016/B978-0-323-96020-5.00041-8.

[42] Ligon, S.C., Liska, R., Stampfl, J., Gurr, M. and Mülhaupt, R., 2017. Polymers for 3D Printing and Customized Additive Manufacturing. *Chemical Reviews*, 117(15), pp. 10212–10290. doi: 10.1021/acs.chemrev.7b00074.

[43] Ziaee, M. and Crane, N. B., 2019. Binder jetting: A review of process, materials, and methods. *Additive Manufacturing*, 28, pp. 781–801. doi: 10.1016/j.addma.2019.05.031.

[44] Marczyk, J., Ostrowska, K. and Hebda, M., 2022. Influence of binder jet 3D printing process parameters from irregular feedstock powder on final properties of Al parts. *Advanced Powder Technology*, 33 (11), pp. 103768. doi: 10.1016/j.apt.2022.103768.

[45] Svetlizky, D., Das, M., Zheng, B., Vyatskikh, A.L., Bose, S., Bandyopadhyay, A., Schoenung, J.M., Lavernia, E.J., Eliaz, N., 2021. Directed energy deposition (DED) additive manufacturing: Physical characteristics, defects, challenges and applications. *Materials Today*, 49, pp. 271–295. doi: 10.1016/j.mattod.2021.03.020.

[46] Tomar, B., Shiva, S. and Nath, T., 2022. A review on wire arc additive manufacturing: Processing parameters, defects, quality improvement and recent advances. Materials Today Communication, 31, pp. 103739. doi: 10.1016/j.mtcomm.2022.103739.

[47] Casalino, G., Karamimoghadam, M. and Contuzzi, N., 2023. Metal Wire Additive Manufacturing: A Comparison between Arc Laser and Laser/Arc Heat Sources. *Inventions*, 8(2), pp. 52. doi: 10.3390/inventions8020052.

[48] Li.B., Wang, L., Wang, B., Li, D., Oliveira, J.P., Cui, R., Yu, J., Luo, L., Chen, R., Su, Y., Guo, J., fu, H., 2022. Electron beam freeform fabrication of NiTi shape memory alloys: Crystallography, martensitic transformation, and functional response. *Materials Science and Engineering: A*, 843, pp. 143135. doi: 10.1016/j.msea.2022.143135.

[49] Rao, V.R., Pattanayak, D. K. and Vanitha, C., 2023. Hot Impression Creep Behavior of AlSi10Mg Alloy Fabricated through SLM Route. *Transactions of the Indian Institute of Metals*, 76(2), pp. 271–277. doi: 10.1007/s12666-022-02663-w.

[50] Šutka, J., Medvecká, D., Koňar, R., Bruna, M. and Matejka, M., 2023. Evaluation of Selected Technological Parameters for Selective Laser Melting of AlSi10Mg Metal Powder. *Manufacturing Technology*, 23 (1), pp. 110–117. doi: 10.21062/mft.2023.003.

[51] Wu, C., Xu, W., Wan, S., Luo, C., Lin, Z. and Jiang.m, X., 2022. Determination of Heat Transfer Coefficient by Inverse Analyzing for Selective Laser Melting (SLM) of AlSi10Mg. *Crystals*, 12(9), pp. 1309. doi: 10.3390/cryst12091309.

[52] Ashwath, P., Xavior, M. A., Batako, A., Jeyapandiarajan, P. and Joel, J., 2022. Selective laser melting of Al–Si–10Mg alloy: microstructural studies and mechanical properties assessment. *Journal of Materials Research and Technology*, 17, pp. 2249–2258. doi: 10.1016/j.jmrt.2022.01.135.

[53] Magerramova, L., Isakov, V., Shcherbinina, L., Gukasyan, S., Petrov, M., Povalyukhin, D., Volosevich, D., Klimova-Korsmik, O., 2021. Design, Simulation and Optimization of an Additive Laser-Based Manufacturing Process for Gearbox Housing with Reduced Weight Made from AlSi10Mg Alloy. *Metals (Basel)*, 12(1), pp. 67. doi: 10.3390/met12010067.

[54] Eom, Y. S., Kim, K. T., Kim, D. W., Jung, S. H., Nam, S.H., J. W., Yang, D. Y., Choe, J., Yu, J. H. and Son, I., 2021. Fabrication and mechanical properties of Al–Si-based alloys by selective laser melting process. *Powder Metallargy*, 64(3), pp. 198–205. doi: 10.1080/00325899.2021.1899470.

[55] Gao, C., Wu, W., J. Shi, Z. Xiao. and Akbarzadeh. A.H., 2020. Simultaneous

enhancement of strength, ductility, and hardness of TiN/AlSi10Mg nanocomposites via selective laser melting. *Additive Manufacturing*, 34, pp. 101378. doi: 10.1016/j.addma.2020.101378.

[56] Uzan, N. E., Ratzker, B., Landau, P., Kalabukhov, S. and Frage, N., 2019. Compressive creep of AlSi10Mg parts produced by selective laser melting additive manufacturing technology. *Additive Manufacturing*, 29, pp. 100788. doi: 10.1016/j.addma.2019.100788.

[57] Schneller, W., Leitner, M., Springer, S., Grün, F. and Taschauer, M., 2019. Effect of HIP Treatment on Microstructure and Fatigue Strength of Selectively Laser Melted AlSi10Mg. *Journal of Manufacturing and Materials Processing*, 3(1), pp. 16. doi: 10.3390/jmmp3010016.

[58] Leon, A. and Aghion, E., 2017. Effect of surface roughness on corrosion fatigue performance of AlSi10Mg alloy produced by Selective Laser Melting (SLM). *Materials Characterization*, 131, pp. 188–194. doi: 10.1016/j.matchar.2017.06.029.

[59] Tahmasbi, K., Muhammad, M., Avateffazeli, M., Yaghoobi, M., Tridello, A., Paolino, D.S., Shao, S., Shamsaei, N. and Haghshenas, M., 2024. Very high cycle fatigue characteristics of laser beam powder bed fused AlSi10Mg: A systematic evaluation of part geometry. *International Journal of Fatigue*, 189 (August), pp. 108544. doi: 10.1016/j.ijfatigue.2024.108544.

[60] Avateffazeli, M., Shakil, S.I., Amir, H., Babak, S.A., Hadi, P., Mahyar, M. and Meysam, H., 2023. On microstructure and work hardening behavior of laser powder bed fused Al-Cu-Mg-Ag-TiB2 and AlSi10Mg alloys. *Materials Today Communication*, 35(March), pp. 105804. doi: 10.1016/j.mtcomm.2023.105804.

[61] Shakil, S.I., Hadadzadeh, A., Pirgazi, H., Mohammadi, M. and Haghshenas, M., 2021. Indentation-derived creep response of cast and laser powder bed fused AlSi10Mg alloy: Air temperature. *Micron*, 150(September), pp. 103145. doi: 10.1016/j.micron.2021.103145.

[62] Shakil, S. I., Hadadzadeh, A., Shalchi Amirkhiz, B., Pirgazi, H., Mohammadi, M. and Haghshenas, M 2021. Additive manufactured versus cast AlSi10Mg alloy: Microstructure and micromechanics. *Results in Materials*, 10(January), pp. 100178. doi: 10.1016/j.rinma.2021.100178.

[63] Alghamdi, F., Song, X., Hadadzadeh, A., Shalchi-Amirkhiz, B., Mohammadi, M. and Haghshenas M., 2020. Post heat treatment of additive manufactured AlSi10Mg: On silicon morphology, texture and small-scale properties. *Materials Science and Engineering: A*, 783(January), pp. 139296. doi: 10.1016/j.msea.2020.139296.

[64] Alghamdi, F. and Haghshenas, M., 2019. Microstructural and small-scale characterization of additive manufactured AlSi10Mg alloy. *SN Applied Sciences*, 1(3), pp. 1–10. doi: 10.1007/s42452-019-0270-5.

[65] Jatti, V.S., Murali Krishnan, R., Saiyathibrahim, A., Preethi, V., Suganya Priyadharshini, G., Abhinav Kumar., Sharma, S., Islam, S., Kozak, D. and Lozanovic, J., 2024. Predicting specific wear rate of laser powder bed fusion AlSi10Mg parts at elevated temperatures using machine learning regression algorithm: Unveiling of microstructural morphology analysis. *Journal of Materials Research and Technology*, 33(September), pp. 3684–3695. doi: 10.1016/j.jmrt.2024.09.244.

[66] Maleki, E. and Shamsaei, N., 2024. A comprehensive study on the effects of surface post-processing on fatigue performance of additively manufactured AlSi10Mg: An augmented machine learning perspective on experimental observations. *Additive Manufacturing*, 86(April), pp. 104179. doi: 10.1016/j.addma.2024.104179.

[67] Fathi, P., Rafieazad, M., Duan, X., Mohammadi, M. and Nasiri, A.M., 2019. On microstructure and corrosion behaviour of AlSi10Mg alloy with low surface roughness fabricated by direct metal laser sintering. *Corrosion Science*, 157, pp. 126–145. doi: 10.1016/j.corsci.2019.05.032.

[68] Palumbo, B., Del Re, F., Martorelli, M., Lanzotti, A. and Corrado, P., 2017. Tensile Properties Characterization of AlSi10Mg Parts Produced by Direct Metal Laser Sintering via Nested Effects Modeling. *Materials (Basel)*, 10(2), pp. 144. doi: 10.3390/ma10020144.

[69] Ghasri-Khouzani, M., Peng, H., Attardo, R., Ostiguy, P., Neidig, J., Billo, R., Hoelzle, D. and Shankar, M.R., 2019. Comparing microstructure and hardness of direct metal laser sintered AlSi10Mg alloy between different planes. *Journal of Manufacturing Processes*, 37, pp. 274–280. doi: 10.1016/j.jmapro.2018.12.005.

[70] Baxter, C., Cyr, E., Odeshi, A. and

Mohammadi, M., 2018. Constitutive models for the dynamic behaviour of direct metal laser sintered AlSi10Mg_200C under high strain rate shock loading. *Materials Science and Engineering: A*, 731, pp. 296–308. doi: 10.1016/j.msea.2018.06.040.

[71] Hadadzadeh, A., Amirkhiz, B.S., Odeshi, A. and Mohammadi, M., 2018. Dynamic loading of direct metal laser sintered AlSi10Mg alloy: Strengthening behavior in different building directions. *Materials & Design*, 159, pp. 201–211. doi: 10.1016/j.matdes.2018.08.045.

[72] Lorusso, M., Aversa, A., Manfredi, D., Calignano, F., Ambrosio, E.P., Ugues, D. and Pavese, M., 2016. Tribological Behavior of Aluminum Alloy AlSi10Mg-TiB2 Composites Produced by Direct Metal Laser Sintering (DMLS). *Journal of Materials Engineering and Performanc*, 25(8), pp. 3152–3160. doi: 10.1007/s11665-016-2190-5.

[73] Manfredi, D., Calignano, F., Krishnan, M., Canali, R., Ambrosio, E. and Atzeni, E., 2013. From Powders to Dense Metal Parts: Characterization of a Commercial AlSiMg Alloy Processed through Direct Metal Laser Sintering. *Materials (Basel)*, 6(3), pp. 856–869. doi: 10.3390/ma6030856.

[74] Vishnu, V., Prabhu, T. R. and Vineesh., K.P., 2024. Effect of hard anodizing and T6 heat treatment on the dry sliding wear behavior of AlSi10Mg fabricated by direct metal laser sintering. *Wear*, 564–565, no. December 2024, pp. 205677. doi: 10.1016/j.wear.2024.205677.

[75] Prasad, R.M., Santhosh, U. N. K. N., Keshava, N. C. and Banakara, N., 2024. DMLS - Based Additive Manufacturing of AlSi10Mg Alloy Samples and Investigation of Heat Treatment Effects on Mechanical Properties for Biomedical Applications. *Journal of The insitution of Engineers (India) Series D*, 0123456789. doi: 10.1007/s40033-024-00850-1.

[76] Bian, H., Aoyagi, K., Zhao, Y., Maeda, C., Mouri, T. and Chiba, A., 2020. Microstructure refinement for superior ductility of Al–Si alloy by electron beam melting. *Additive Manufacturing*, 32, pp. 100982. doi: 10.1016/j.addma.2019.100982.

[77] Calignano, F., Mercurio, V., Rizza, G. and Galati, M., 2022. Investigation of surface shot blasting of AlSi10Mg and Ti6Al4V components produced by powder bed fusion technologies. *Precision Engineering*, 78, pp. 79–89. doi: 10.1016/j.precisioneng.2022.07.008.