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CRITICAL REVIEW

A review on factors influencing mechanical properties of AlSi12 alloy processed by selective laser melting

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Abstract
AlSi12 has a high strength-to-weight ratio and good corrosion resistance properties. As a result, it has potential for use in the automotive and aerospace industries. However, AlSi12 is difficult to process using conventional manufacturing technologies because of its characteristics of having high thermal conductivity and reflectivity and flowability is low. It is necessary to explore how emerging manufacturing technologies can be used to effectively process it. Additive manufacturing (AM) offers great design freedom. For the AM of metallic parts, several technologies are in use, including selective laser melting (SLM), electron beam melting, laser engineered net shaping, and cold spray additive manufacturing. Among these AM processes, SLM technology is a cutting-edge manufacturing technique that has the potential to change the way people think about design and production. SLM of AlSi12 alloy presents unique advantages in producing components with high strength and low weight while having increased design freedom. However, there is a need for more information on how SLM can be effectively used to manufacture AlSi12 parts in a way that reduces defects without compromising the mechanical properties. Thus, this paper aims to review the factors that influence the mechanical properties of AlSi12 alloy printed parts produced using SLM. This information is useful in determining the factors that can be considered for manufacturing parts with outstanding characteristics.

Keywords Selective laser melting · AlSi12 alloy · Powder particle size · Mechanical properties

1 Introduction

Additive manufacturing (AM) allows for the manufacture of topographically optimized parts with complicated shapes [1]. As a result, the product's functional integrity can be ensured and enhanced at an early design level. Based on previous research, AM can be classified into different processes. Among them, selective laser melting (SLM) is the most used method for metal AM [2]. This method can be used to manufacture complex geometries that are costly to produce using conventional methods. SLM has several undeniable benefits over traditional production methods such as extrusion, grinding, powder metallurgy, and casting [3]. These benefits include the ability to manufacture maximum density three-dimensional components of complicated shapes, limited post-processing requirements, versatility in fabricating complex molded metal matrix composites, and so on [3]. Figure 1 shows an overview of the SLM process.

A layer of metal powder is subsequently applied to a substrate surface using a powder coating system in the SLM technique. After depositing, the layer of powder gets melted according to a set scanning pattern. Following the scanning of a layer, the build platform drops down to a set distance (usually 20 to 40 µm in SLM), and then another layer is produced and scanned. The whole procedure takes place until the parts are entirely constructed [4].

The AlSi12 alloy has a lot of promise for SLM, particularly in the transport sector because of its excellent characteristics such as resistance to corrosion and high strength-to-weight ratio. This helps to reduce the weight of vehicle

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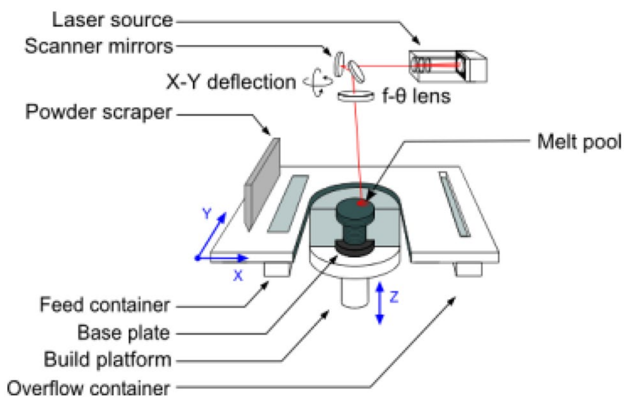


Fig. 1 Schematic diagram of the selective laser melting (SLM) powder-bed process [4]

parts, hence reducing the overall vehicle weight and fuel consumption [2, 5].

SLM provides distinctive advantages for AlSi12 (intricate design, tool-less welding, personalized style, and geometric freedom) [6]. Researchers are more interested in processing the Al–Si alloy to produce components with the required characteristics using SLM. Al powders have limitations such as high thermal conductivity, and reflectivity, and their flowability is low [2]. Furthermore, they have poor laser absorption and are easily oxidized and balled. Regardless of these limitations, aluminum may be alloyed with other metallic materials to solve any of these problems. AlSi10Mg and AlSi12 are the two Al–Si alloys that are commonly used in SLM. Silicon increases the fluidity of aluminum, thereby lowering the melting temperature.

It was reported by Spierings et al. [7] that finer particles have advantages for high component densities, scan surface consistency, and process productivity. Liu et al. [8] also showed that powder with fine particle content results in high component density. Rijesh et al. [9] reported that when grain sizes are in the nanometer range, there is a substantial difference in mechanical characteristics (strength, ductility, and hardness). However, the knowledge of how the particle size of the starting powder of AlS12 alloy synthesized via SLM can significantly reduce the defects of the produced parts is still limited.

Rashid et al. [10] reported that varying a scan strategy can result in significantly different microstructural and mechanical properties of the produced components. Maamoun et al. [11] also conducted a study to see how processing parameters influence the surface's porosity, relative density, and roughness. Authors have reported on different processing parameters in deriving the anticipated performance characteristics. It is highly recommended to understand the influence of varying processing parameters and other factors on the properties of the printed parts. Thus, this paper presents a review of the factors that influence the mechanical properties of AlSi12 alloy processed using SLM. Section 2 outlines the factors that influence the mechanical properties of AlSi12. Section 3 includes the developments over time on the processability of AlSi12 alloy. Discussion is found in Sect. 4 and Sect. 5 outlines conclusion.

2 Factors affecting the mechanical properties of AlSi12 alloy

2.1 Effect of particle sizes on the built components for different materials

Table 1 below shows that there is a lot of curiosity in understanding the SLM processability of various alloys with various particle sizes. It is clear from Table 1 that there is a common interest in studying the behavior of the particle sizes on the built part, and it was seen that reducing the powder sizes improves the quality of SLM parts. Most of the research was conducted using micro-sized powder particles.

2.2 Effect of process parameters and heat treatment on mechanical properties of AlSi12 alloy by SLM

The authors used different processing parameters to enhance the resultant mechanical properties. The mechanical properties of focus are hardness, tensile strength, compressive strength, wear, and fatigue. Physical property is density.

2.2.1 Density and hardness

Baitimerov et al. [6] processed AlSi12 alloy through SLM to study the characteristics of the used powder during the manufacturing process. Three varying batches of gas atomized powders from separate vendors were used while adhering to the following parameters: the laser power was 200 W, the 50-μm layer thickness was stripe hatch, the drying of powder was done for 1 h at 100 °C, and there was 500 ppm of oxygen inside the chamber.

According to the findings, the relative density was ≥ 95%. The formed powder particles were very fine and spherical, showing poor processability in SLM, while the opposite is true with AlSi12 powder (Fig. 2). The particles with a roughly spherical morphology had poor flowability. This poor flowability results in higher porosity values (Fig. 3).

In another study, Baitimerov et al. [6] looked at the processing of AlSi12 by SLM to see what process parameters would result in the least number of pores. Samples had a variety of microstructures with a porosity of around 0.5%. The flowability of the AlSi12 powders was discovered to be slow. The surface morphology of the samples shows that they have a rough surface. To minimize surface roughness

Table 1 The effects of particle sizes on the built components for different materials

Method/study	Findings	Reference
Explored the densification behaviour of gas and water atomized 316L stainless steel powders, 3–40 µm and 6–50 µm respectively	The results demonstrated that the parts fabricated with the gas atomized powders acquired a higher relative density, less porosity compared to those with the water atomized powders	[28]
Investigated 316L stainless steel powders with 2 types of particle size (Sandvik Osprey (SO) particle size 0–45 µm and LPW technology in the range 15–45 µm) distributions and the properties of as-built part using SLM	The results indicated that powder with different particle size distributions behave differently and thus cause a difference in an as-built part's quality	[29]
Examined the effect of different powder sizes of the 316L stainless steel on the part quality in the SLM process	They reported that the metal powders of a smaller size tended to reduce porosities in the fabricated parts compared to those of a larger size. The relative density (99.75%–26.36 µm) (97.50%–50.81 µm)	[28]
Investigated the effect of Ti-6Al-4 V powder variation of 20 µm to 50 µm on the powder bed thermophysical properties and the microstructure and tensile strength of as-built SLM parts	It was found that there is a difference in flowability and porosities of the different powders, there was no significant difference in powder bed densities of 3 types of Ti-6Al-4 V powder	[30]
Investigated the powder particles of 316L stainless	They reported that high fine particle content results in a higher powder bed density, which leads to higher density sections under low laser energy intensity	[29]
Compared the SLM processing activity of three 316L stainless steel powder batches with different particle size distributions	They discovered that fine particles are advantageous for high component densities, process productivity, and scan surface consistency	[31]
Investigated the effect of three separate AlSi12 powders on SLM processability (with differing particle size distribution, morphology, and chemical composition). Powder B had large amount of fine particles (< 25 µm) than powder batches A and C	It demonstrated that the flowability of the powder as well as the apparent density of AlSi12 SLM samples influence their processability	[6]

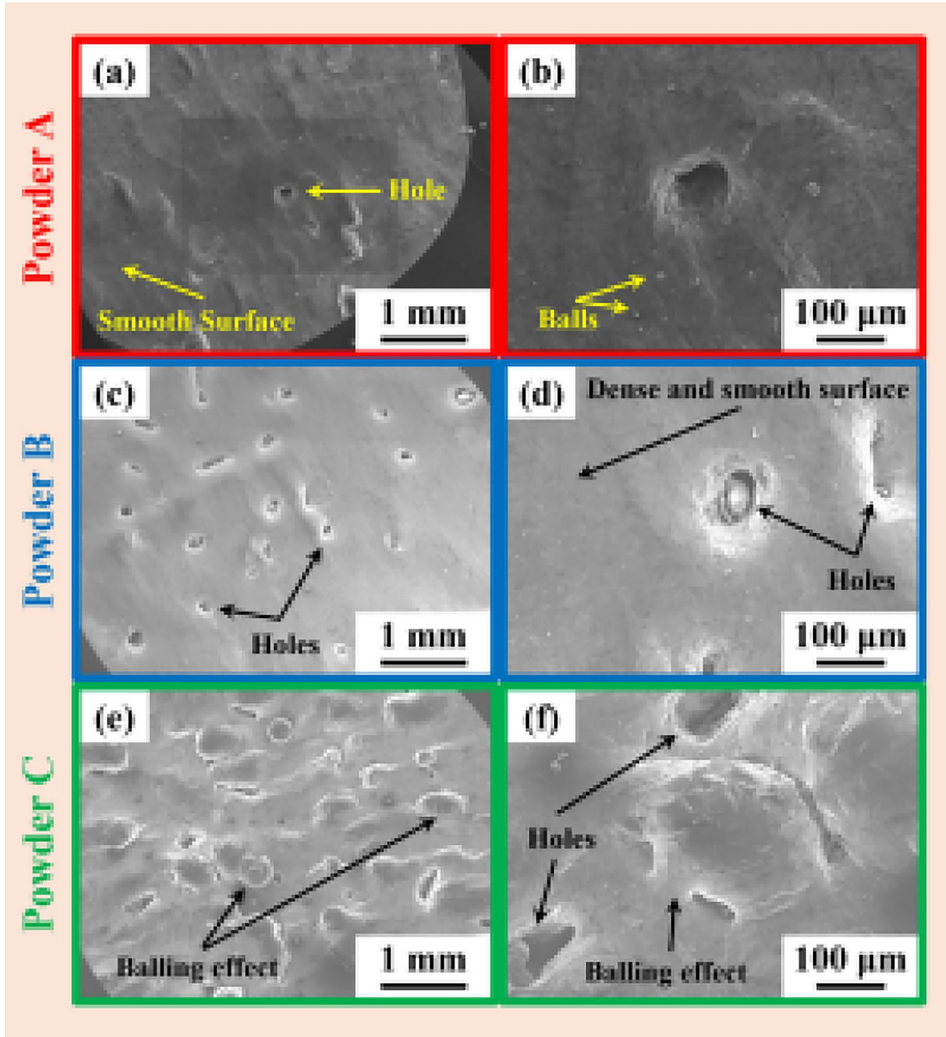


Fig. 2 SEM images of surface morphologies of AlSi12 alloy, processed by SLM from 3 varying powder sets; powder **A** (**a**, **b**), powder **B** (**c**, **d**), and powder **C** (**e**, **f**) [6]

and porosity, a fine AlSi12 powder and a double-pass laser scanning strategy were proposed.

According to the study by Rashid et al. [12], a relative density of 99.8% was obtained with an energy per layer of between 504 and 895 J. Samples had yield strength, tensile strength, and ductility of 225–263 MPa, 260–365 MPa, and 1–4%, respectively.

Chou et al. [13] suggested a new method for controlling the heat input in AlSi12 by using pulsed SLM instead of traditional SLM. They used a laser with a power range of 0.5–4.5 kW, a travel speed of 90–180 mm/min, a 150-m spot size, a 0.1-mm hatch distance, and a 0.1-mm layer thickness to process the AlSi12 alloy. It has been proven that by printing with a pulsed laser, Si may be refined to a size of less than 200 nm. The print component density and hardness were 95% and 135 HV, respectively.

Wang et al. [14] investigated how AlSi12 samples produced through SLM are influenced by the build chamber environment. When the samples were printed in argon, nitrogen, or helium chamber atmospheres, there was no discernible difference in density or hardness. The samples outperformed conventionally produced material by 1.5 times yield strength, 20% higher tensile strength, and twice the elongation.

The parameters needed to achieve a consistent relative density for the AlSi12 alloy generated by SLM were studied by Louvis et al. [15]. Laser intensity and laser scanning rate were the process parameters studied. Based on their results, the oxidation factor was the most important parameter that impacted relative density. Experimentally, two different SLM devices were employed, each with a different laser power: one with 50 W and the other with 100 W. A relative density of 89.5% was obtained from the system of 100-W laser power with a combination of optimum parameters. Oxide formation should be prevented to create AlSi12 components with a 100% relative density.

2.2.2 Tensile and compressive strength

Tensile strength Kang et al. [16] investigated the microstructure and strength of an in situ produced eutectic Al–Si

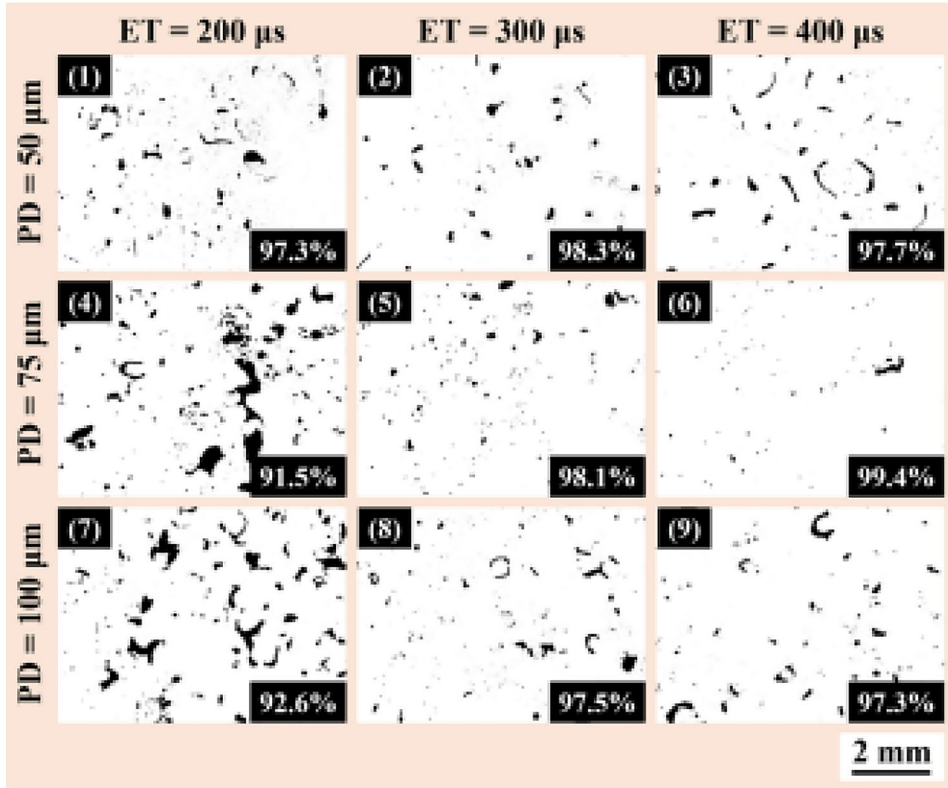


Fig. 3 Change in porosity of AlSi12 alloy processed from one powder batch, changing the point distance (PD) and exposure time (ET) [6]

alloy made from an elemental powder combination utilizing selective laser melting. A dense eutectic Al–Si alloy (approximately 99%) was produced using an argon atmosphere. The rapid cooling rate of SLM resulted in a microstructure with nano-sized Si particles and cellular Al. The ductility and tensile strength of SLM-treated materials diminish as the laser scanning speed rises. The pre-alloyed powder needs more energy density to produce denser samples from in situ SLM fabrication. Similarly, a controlled and ultrafine microstructure of AlSi12 treated by SLM was described in research by Li et al. [17]. Nonetheless, they performed a solution heat treatment for 4 h at 500 °C, followed by water quenching. At the Al grain boundaries, spherical Si particles formed. On the other hand, the coarse and fine Si precipitates were evenly dispersed throughout the Al matrix. The tensile characteristics improved after heat treatment as it was seen in the microstructure and had an extraordinarily high ductility of around 25%.

The tensile behavior of AlSi12 produced by SLM was studied by heating the base plate and experimenting with four different hatch types [18]. The following parameters were used: 320-W laser, 50-μm layer thickness, 110-μm hatch spacing, 73° hatch rotation, argon atmosphere, scanning speed of 1455–1939 mm/s, checkerboard, single and double melt, and single melt continuous scanning methods were used. A solution heat treatment for 6 h at 473–723 K was done. According to the findings, the differences in tensile characteristics were linked to fracture propagation route variance. The ductility of the samples manufactured without using contour scans increased significantly without losing tensile strength. With the right processing parameters, the tensile characteristics at room temperature can be adjusted in situ. Prashanth et al. [19] used the same parameters as Prashanth et al. [18] to investigate the mechanical properties of AlSi12 components produced through SLM. The findings revealed that the built sample had a yield and tensile strength of 380 and 260 MPa, respectively, which were substantially greater when compared to the yield and tensile strength of cast equivalents. Contrary to Prashanth et al. [18], the microstructures' texture of the produced samples changed depending on the construction orientation; however, this did not affect the tensile characteristics.

Compressive strength Ponnusamy et al. [20] studied the behavioral change of the AlSi12 alloy manufactured through SLM at high strain rates. Different scanning techniques were used to treat the alloy, with a focus distance of 4 mm, 1000-mm/s scanning speed, 285 W of laser power, 100 μm of hatch spacing, and a 40-μm layer thickness. Horizontal, inclined, and vertical construction orientations were used. According to the findings, the dynamic compressive strength rose as the print orientation angle grew from 0° to 90°. At 200 °C, the compressive and yield strength of the produced samples decreases. At increased temperatures, flow stress was greater for dynamic loading than for quasi-static loading. The same parameters were utilized in the work by Ponnusamy et al. [21], and a post-treatment of annealing for 3 h at 200 °C and 400 °C was performed. On the contrary, a reduction in flow stress was observed because of thermal softening occurring in printed samples that are exposed to high temperatures. The heat-treated samples showed a significant decrease in flow stress. The samples that were heat-treated at 200 °C and 400 °C showed a decrease in flow stress of 12 and 45%, respectively.

2.2.3 Wear and fatigue

Wear Prashanth et al. [19] investigated the mechanical characteristics of AlSi12 alloy that was produced using SLM. When compared to cast equivalents, the as-built samples demonstrated superior resistance to wear and comparable corrosion resistance. Annealing heat treatment which caused the development of Si precipitates degraded both wear and corrosion characteristics. Rathod et al. [22] who investigated the tribological characteristics of the Al–12Si alloy agree with Prashanth et al. [19] that annealing causes Si to precipitate and the cellular structure to disintegrate, leading to a decrease in hardness. Similarly, they also found that when comparing the heat-treated SLM to the CC specimens, the as-prepared SLM specimens had the lowest wear rate. Although the hardness of SLM specimens manufactured using single melt (SM) and checkerboard (CB) scanning methods is equal, the wear rate of the former is substantially higher because of its high porosity.

Fatigue Siddique et al. [23] studied the high cycle fatigue failure processes in AlSi12 alloys that were processed by SLM. The following parameters were used: 400 W of laser power, 39.6 J/mm^3 of volume energy density, argon environment, stress relief heat treatment at 240 °C for 2 h was done, followed by cooling in the oven. The microstructure of the printed samples was found to include precipitates and tiny grains, resulting in enhanced quasi-static strength when compared to their cast counterparts. The as-built and as-built hybrid samples were comparable in terms of fatigue strength.

Siddique et al. [24] conducted a study assessing the performance of fatigue for selective laser melted parts. The X-ray and optical microscopy computed tomography methods showed similar porosity percentages. The loss in strength caused by hot isostatic pressing after treatment was equivalent to that of die-cast components. The presence of even smaller holes in the samples was considered responsible for the reduction in fatigue life. The post-treatment of hot isostatic pressing reduced the effect of surface weakening.

Siddique et al. [25] investigated the fatigue behavior of the AlSi12 alloy that was produced through SLM. According to the findings, the stress reduction after a heat treatment at 240 °C resulted in increased pores owing to the formation of new pores. After comparing the two samples, the ones produced with and without the base plate heating, the results revealed that the ones produced with base plate heating had better fatigue performance at low loads. The porosity of those produced without base plate heating was greater, making them more susceptible to breaking owing to faults. For samples produced using base plate heating, this incidence was considerably decreased. Siddique et al. [26] investigated the impact of process-induced microstructure and defects on the mechanical characteristics of AlSi12 treated by SLM and agreed with Siddique et al. [25] that base plate heating had a positive impact. They discovered that because the cooling rate is reduced when the base plate is heated, the produced samples have a coarser granular microstructure. The printed samples have four times the tensile strength of sand-cast components and two times the tensile strength of die-cast parts. Residual stresses and fatigue data scatter were lower in samples made with base plate heating.

Suryawanshi et al. [27] studied the influence of SLM on the simultaneous improvement of toughness and strength in an AlSi12 alloy. The results indicated that SLM alloys had lower crack development caused by fatigue and un-notched fatigue strength than cast alloys, which may be related to shrinkage porosity, unmelted particles, and tensile residual stresses. The inclusion of mesostructure Si in the printed samples resulted in increased toughness. Toughness was shown to be affected by crack and scan orientations concerning the construction.

Table 2 summarizes the mechanical characteristics of SLM-printed AlSi12, thereby showing the effects of build orientation and heat treatment on hardness, yield strength (YS), and ultimate tensile strength (UTS). The dynamic compressive properties are as follows: UTS, ultimate compression strength, YS and strain, and lastly the fatigue and fracture toughness.

It is clear from Table 2 that the AlSi12 alloy processed by SLM did not receive more attention for mechanical characterization in terms of heat treatment. Further research is needed to study the properties of the Al–Si alloys manufactured through SLM under varying heating effects, high temperatures, and wear.

3 Developments overtime on the processability of AlSi12 alloy

Figure 4 shows the studies that have been conducted on build orientation, heat treatment, and process parameter optimization of AlSi12 alloy over years. The included studies were

Table 2 Mechanical properties of AlSi12 alloy manufactured by SLM [2]

Effect of build orientation:				
Build orientation[a]	**Hardness[b]**	**YS (MPa)**	**UTS (MPa)**	**Strain (%)**
H, V	–	270(H) 274(H)	325(H) 296(V)	4.4(H) 2.2(V)
H, I, V	–	227(H) 263(I) 224(V)	260(H) 367(I) 398(V)	2.0(H) 4.5(I) 5.0(V)
Effect of heat treatment:				
AB/HT[c]	**Hardness[b]**	**YS (MPa)**	**UTS (MPa)**	**Strain (%)**
AB	–	290	460	-
AB	–	263	365	-
AB	–	201	361	4
AB	115	249 (max)	368 (max)	4.8
AB	–	240	325	-
HT	–	138	207	-
AB	–	220	418	3.9
HT	–	218	372	3.4
HT	–	102	425	12
Dynamic compressive properties:				
QS/D[d]	**UTS (MPa)**	**UCS (MPa)**	**YS (MPa)**	**Strain (%)**
D-C at RT	–	550	400	0.18
D-C at 200 °C	–	490	270	0.18
Fatigue and fracture toughness:				
Other tests[e]	**Fatigue strength/no. of cycles**		**Fracture toughness ($MPa \cdot m^{0.5}$)**	
AF	10^9 at 60.5 ± 4.7 MPa		–	
FT	–		19.7	

[a]V (vertical), I (inclined at 45°), H (horizontal)

[b]HV (Vickers hardness)

[c]AB/HT (as-built, heat-treated)

[d]QS (quasi-static testing), D-C (dynamic-compression testing)

[e]AF (axial fatigue), FT (fracture toughness)

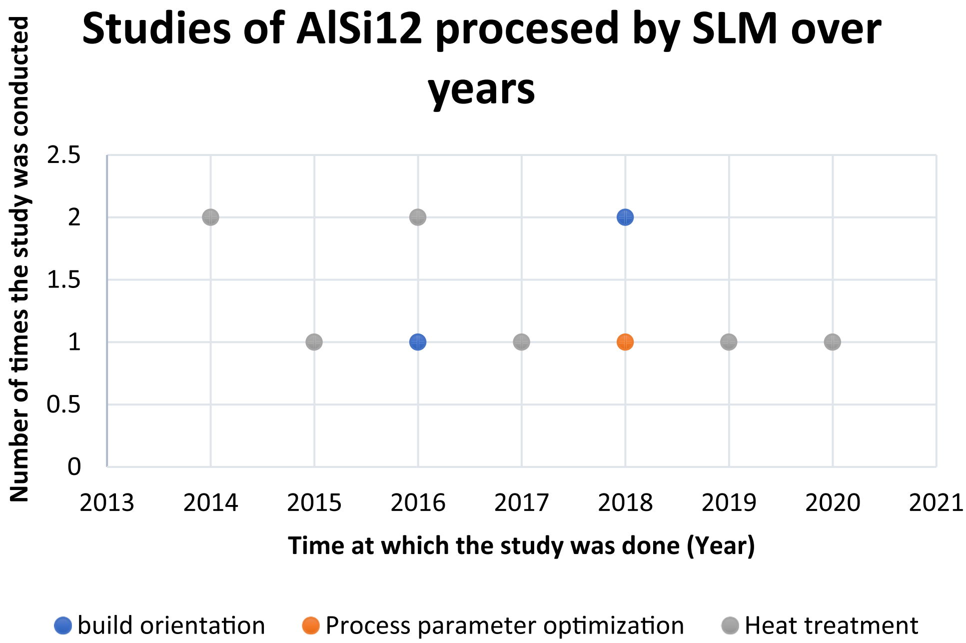


Fig. 4 Studies conducted on mechanical properties of AlSi12 processed by SLM from different years

conducted between 2014 and 2020. Much work was done on heat treatment of AlSi12 alloy. Thus, more work needs to be done on optimizing the process parameters and build orientation of AlSi12 to understand their behavior better.

Table 3 shows the description of conducted studies in different years. Lately, there has not been much work done on AlSi12 through SLM. There is a balance in the number of studies carried out in 2015 and 2018.

Table 3 The description of work done in different years

Paper description	Year
Dynamic compressive behaviour of selective laser melted AlSi12 alloy: Effect of elevated temperature and heat treatment	2020
Tribological properties of selective laser melted Al 12Si alloy	2019
Selective laser melting of aluminium components	2019
Influence of Powder Characteristics on Processability of AlSi12 Alloy Fabricated by Selective Laser Melting	2018
Effect of Selective Laser Melting Process Parameters on the Quality of Al Alloy Parts: Powder Characterization, Density, Surface Roughness, and Dimensional Accuracy	2018
Effect of energy per layer on the anisotropy of selective laser melted AlSi12 aluminium alloy	2018
High strain rate dynamic behaviour of AlSi12 alloy processed by selective laser melting	2018
Defining the tensile properties of Al-12Si parts produced by selective laser melting	2017
High and Very High Cycle Fatigue Failure Mechanisms in Selective Laser Melted Aluminum alloys	2017
Very high cycle fatigue and fatigue crack propagation behavior of selective laser melted AlSi12 alloy	2017
Microstructure and strength analysis of eutectic Al-Si alloy in-situ manufactured using selective laser melting from elemental powder mixture	2016
Simultaneous enhancements of strength and toughness in an Al-12Si alloy synthesized using selective laser melting	2016
Additive Manufacturing of Al-12Si Alloy Via Pulsed Selective Laser Melting	2015
Influence of process-induced microstructure and imperfections on mechanical properties of AlSi12 processed by selective laser melting	2015
A selective laser melting and solution heat treatment refined Al–12Si alloy with a controllable ultrafine eutectic microstructure and 25% tensile ductility	2015
Computed tomography for characterization of fatigue performance of selective laser melted parts	2015
The effect of atmosphere on the structure and properties of a selective laser melted Al–12Si alloy	2014
Microstructure and mechanical properties of Al–12Si produced by selective laser melting: Effect of heat treatment	2014

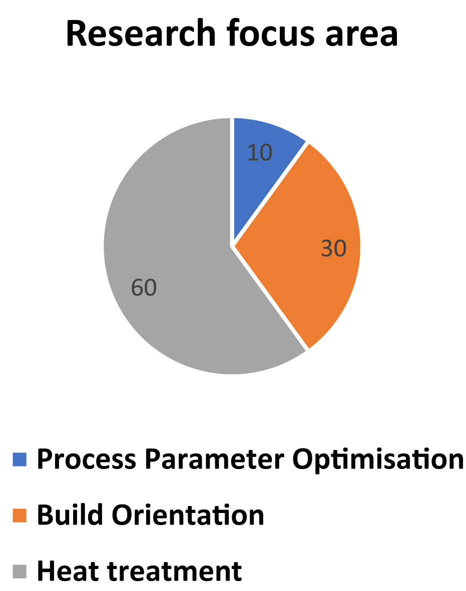


Fig. 5 Research focus area of AlSi12 processed by SLM

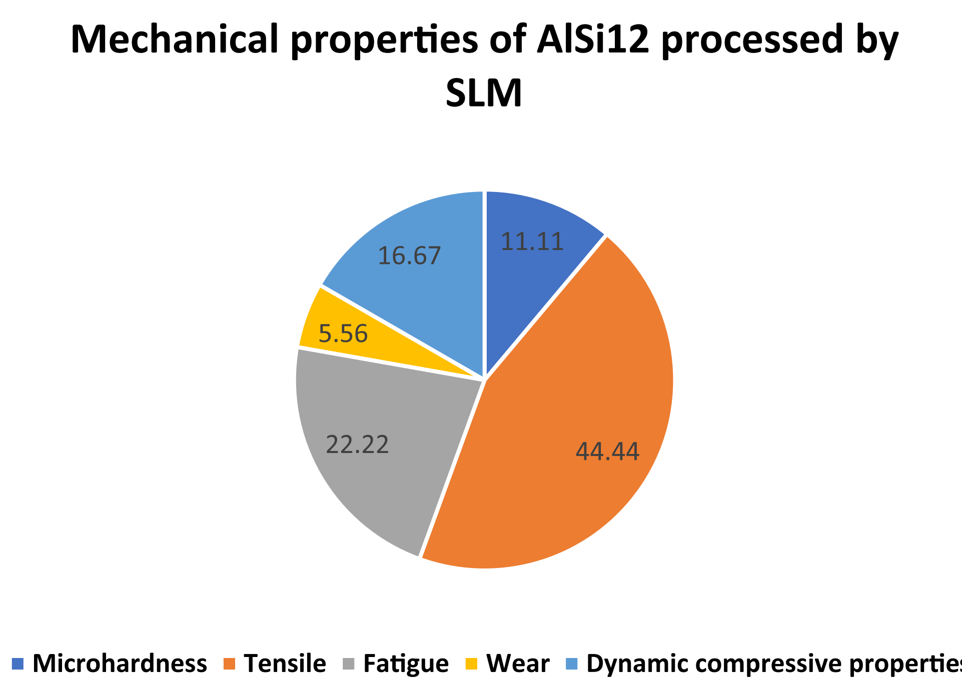
Figures 5 and 6 illustrate the pie charts of the research focus area and mechanical properties of AlSi12 processed by SLM respectively. From the research focus area, heat treatment received much attention with 60% of study being conducted on it. Less work was done on build orientation, shown by 10%. From Fig. 6, it can be shown that the tensile property was studied a lot more than other mechanical properties.

4 Discussion

The purpose of this work was to look at factors that influence the mechanical properties of AlSi12 alloy. Some of the included factors are particle size, heat treatment, build orientation, and processing parameters:

- Under density and hardness behavior, it has been reported that oxidation is another factor that influences relative density. Therefore, it must be avoided when producing AlSi12 components with a 100% relative density using SLM. The particles with a nearly spherical morphology had limited flowability, resulting in high porosity levels. From the literature, it was reported that there are no significant differences in hardness or density when the chamber's atmospheres are varied [14]. In other studies, SLM had been used to create the AlSi12 alloy, with 99.89% relative density [12]. Although there is a substantial influence of utilizing fine-fraction powder and a scanning approach that incorporates a double-pass laser scan strategy to decrease surface roughness and porosity, there has been little research on the behavior of particle sizes on the produced component.
- About 44.4% of studies have been conducted on tensile strength. It was seen that the ductility and tensile strength of SLM-treated materials diminish as the laser scanning speed rises. The samples printed without a contour scan showed a substantial improvement in ductility while maintaining tensile strength. Findings show that the ten-

Fig. 6 Mechanical properties of AlSi12 processed by SLM



sile characteristics at room temperature may be adjusted in situ with the right process parameters.

- In terms of compression strength, it was discovered that when the print orientation angle rose from 0° to 90°, the dynamic compressive strength increased. When printed samples are evaluated at 200 °C, their compressive and yield strengths tend to be reduced. The flow stress becomes greater for dynamic loading than for quasi-static loading at increased temperatures. Heat treatment, on the other hand, results in a substantial decrease in flow stress.
- Regarding wear, the as-built samples outperform their cast counterparts with greater wear resistance and equal corrosion resistance. The development of Si precipitates after heat treatment (annealing) causes wear and corrosion characteristics to decrease. Annealing also induces Si precipitate and cellular structure disruption, which results in a loss in hardness. Furthermore, when compared to the CC specimen, the as-prepared SLM specimens had the lowest wear rate after heat treatment.
- According to the fatigue observations, stress reduction after a heat treatment at 240 °C resulted in increased porosity owing to the development of pores. Furthermore, at low loads, the samples produced with base plate heating outperformed the samples produced without base plate heating in terms of fatigue performance. Because the cooling rate is reduced while the base plate is heated, the printed samples have a coarser grain microstructure. When samples are printed using base plate heating, residual stresses are significantly reduced.

5 Conclusion

There is a lack of knowledge of how the particle size can reduce the defects of SML printed parts. Most of the research was done with micro-sized powder particles. As a result, there is a need to research the nano-scaled powder particles of AlSi12 to understand how they affect the mechanical properties of SLM-produced components.

The conducted studies on heat treatment focused on techniques that are frequently utilized for traditionally made aluminum alloys, which may not be suitable for SLM-printed components due to their inherent properties. More study is needed to produce an optimal heat treatment for the AlSi12 alloy to increase its mechanical and tribological characteristics.

Author contribution This work was carried out in collaboration with all authors: Ms. Neo Kekana, Dr. Mxolisi B Shongwe, Prof. Khumbulani Mpofu, and Dr. Rumbidzai Muvunzi. Ms. Neo Kekana designed the study, reviewed the articles, and drafted the original manuscript. Dr. Mxolisi B. Shongwe, Prof. Khumbulani Mpofu, and Dr. Rumbidzai Muvunzi reviewed the draft manuscript. The final manuscript was read and approved by all authors.

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Code availability N/A.

Declarations

Ethics approval N/A.

Consent to participate N/A.

Consent for publication I, author Ms. Neo Kekana, give my consent for the publication of identifiable details, which can include a photograph(s) and or details within the text ("Material") to be published in the above Journal and Article.

Conflict of interest The authors declare no competing interests.

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