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Performance and Characterization of Alsi10mg as Additive Base Material

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ABSTRACT

Additively manufactured also pertained to as 3D printing relates to the technologies that construct a three- dimensional device by adding raw material subcaste- by- subcaste consistent with CAD. AM is critical for no tooling to deliver a working part. This system is achievable for constructing parts of the compound configuration that are generally highly impossible to be manufactured by the conventional manufacturing operation. In the current work AlSi10Mg powder was used to build SLM parts according to various ASTM standards and were tested for microstructure, mechanical and wear properties. SEM was used to analysis surface morphology, fracture, and wear morphology. Overall, Additively created techniques focus on engineering metals from the perspective of the machine-driven solid products of the components, making it possible to employ them as widely as possible. Findings proven that the effects of addition of Si and Mg on the progression of the stage structure and microstructure of aluminum alloy produced using additive manufacturing were examined. AlSi10Mg that has undergone selective laser melting might also have comparable Wear resistance to conventional processes. Additive manufacturing is a growing field of engineering that allows us to produce complex goods without the use of conventional industrial course development.

Keywords : AM Process, SLM, Hardness, Fractography, Wear

I. Material and Methodology

Chemical composition of AlSi10Mg:

Powder obtained from AlSi10Mg is generally used in AM, owing to the ability to provide, high mechanical strength, and low density [31]. AM parts usually consume less amount of thermal postprocessing when compared with the traditional produced products. dynamic toughness, good strength and hardness can be obtained in forged aluminum alloy AlSi10Mg which is usually age hardened. The application

AlSi10Mg is used in most valuable industries such as aerospace and automobile industries.

Material composition (weight%)		
Element	Minimum	Maximum
Al		Rest
Si	9.0	11.0
Fe	-	0.55
Cu	-	0.05
Mn	-	0.45
Mg	0.20	0.45
Ni	-	0.05
Zn	-	0.10
Pb	-	0.05
Sn	-	0.05
Ti	-	0.15

Table 1 : Chemical composition of the AlSi10Mg powder [31]

Application of AlSi10Mg Alloy:

In SLM of AlSi10Mg, chemical composition, powder form and distribution of size are essential for powder layer deposition, and because the formed element is better than the alternatives [34].

The effect of additive manufacturing from the build setup to post processing treatments such as heat treatments can be withstood by the AlSi10Mg of electrical resistivity. Therefore, AM is studied whether it has the potential to be a new manufacturing technique for electrical designs. From the outcome of the research designing of unique antennas, coils for the electric motors and other electromagnetic devices can be manufactured using AM from which the conventional manufacturing process can be reduced [35].

Hardness Test

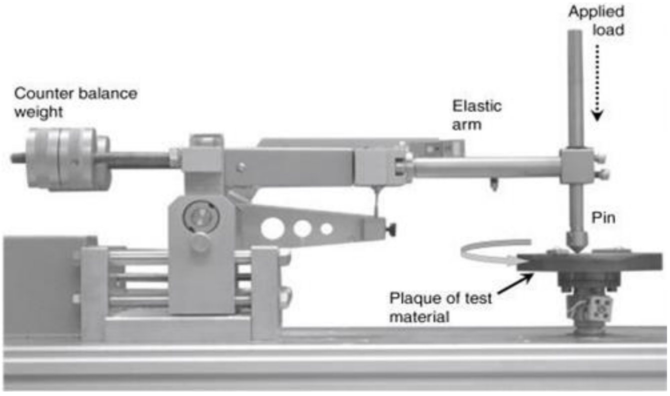


Figure 1 : Pin on disc wear testing machine [49].

II. Results and Discussions

The below tabulated table shows the effects of Density test, Hardness test, Tensile Test, Wear Test, and microstructures of AlSi10Mg From SLM treating structures.

Table 2 : Parameters to build AlSi10Mg sample.

S/No	Sample No	P (W)	SS (mm/s)	D_h (mm)
1	Sample 1	100	200	0.05
2	Sample 2	100	300	0.07
3	Sample 3	100	400	0.09
4	Sample 4	150	200	0.07
5	Sample 5	150	300	0.09
6	Sample 6	150	400	0.05
7	Sample 7	200	200	0.09
8	Sample 8	200	300	0.05
9	Sample 9	200	400	0.07

Table 3 : Hardness test results

S/No	Sample No	P (W)	SS (mm/s)	D_h (mm)	Hardness (VHN)
1	Sample 1	100	200	0.05	189.5
2	Sample 2	100	300	0.07	184.1
3	Sample 3	100	400	0.09	178.2
4	Sample 4	150	200	0.07	194.5
5	Sample 5	150	300	0.09	191.3
6	Sample 6	150	400	0.05	175.4
7	Sample 7	200	200	0.09	169.2
8	Sample 8	200	300	0.05	171.8
9	Sample 9	200	400	0.07	180.8

Tensile Test:

Table 4 : Tensile test results

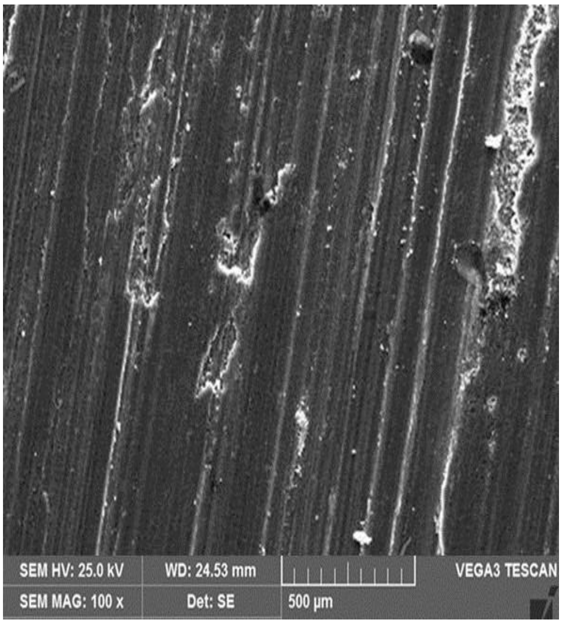
S/No	Sample No	P (W)	SS (mm/s)	D_h (mm)	Tensile (UTS)
1	Sample 1	100	200	0.05	337.4
2	Sample 2	100	300	0.07	331.2
3	Sample 3	100	400	0.09	321.3
4	Sample 4	150	200	0.07	344.6
5	Sample 5	150	300	0.09	340.9
6	Sample 6	150	400	0.05	318.7
7	Sample 7	200	200	0.09	311.2
8	Sample 8	200	300	0.05	315.4
9	Sample 9	200	400	0.07	327.8

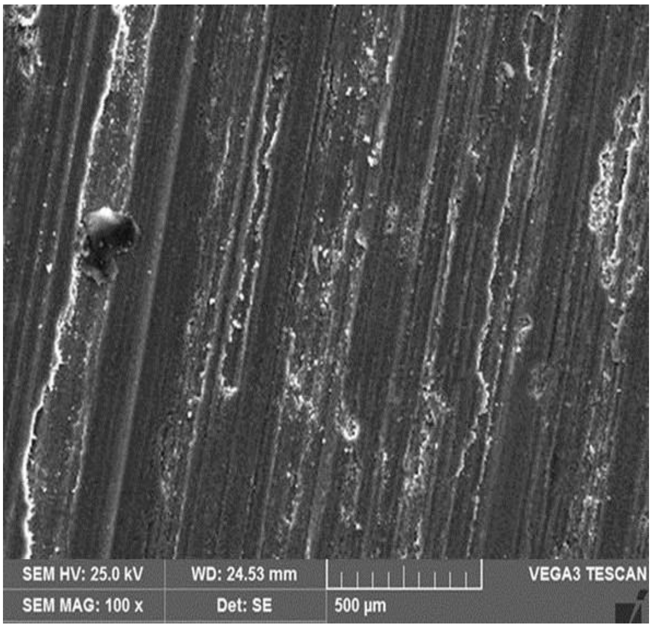
SEM fracture images of AlSi10Mg after tensile test

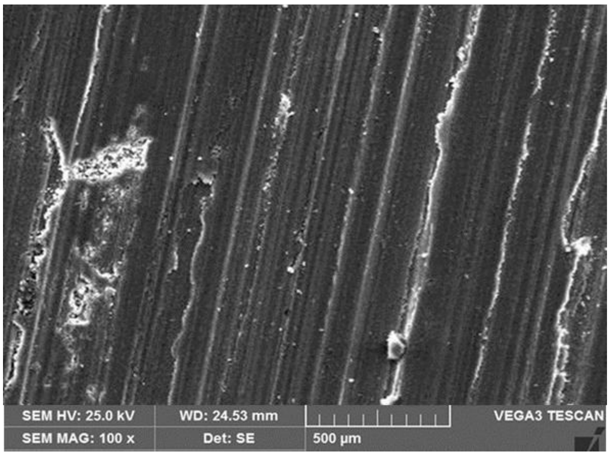
Wear Test:

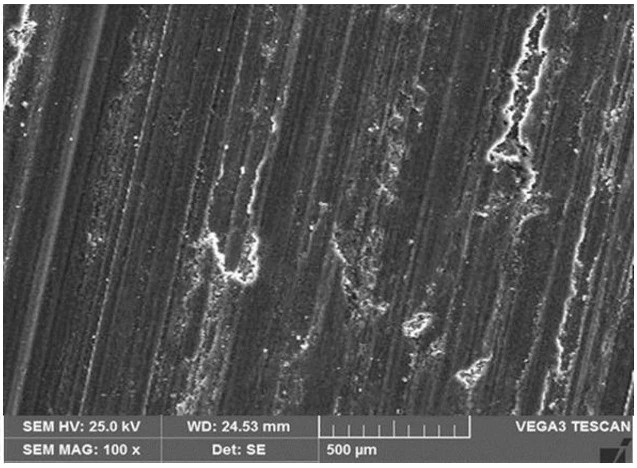
Table 5 : Wear test results

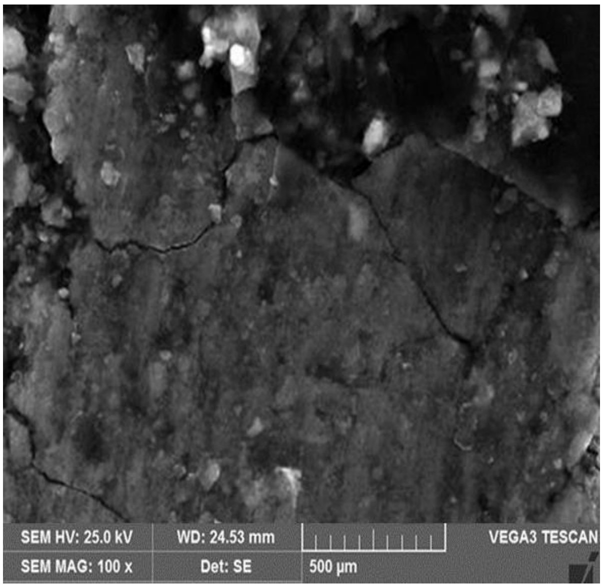
S/No	Sample No	P (W)	SS (mm/s)	D_h (mm)	Wear (µm)
1	Sample 1	100	200	0.05	91.5
2	Sample 2	100	300	0.07	94.8
3	Sample 3	100	400	0.09	99.8
4	Sample 4	150	200	0.07	84.7
5	Sample 5	150	300	0.09	87.8
6	Sample 6	150	400	0.05	103.2
7	Sample 7	200	200	0.09	110.1
8	Sample 8	200	300	0.05	105.3
9	Sample 9	200	400	0.07	96.7






SEM HV: 25.0 kV
WD: 24.53 mm
VEGA3 TESCAN
SEM MAG: 100 x
Det: SE
500 µm


SEM HV: 25.0 kV
WD: 24.53 mm
VEGA3 TESCAN
SEM MAG: 100 x
Det: SE
500 µm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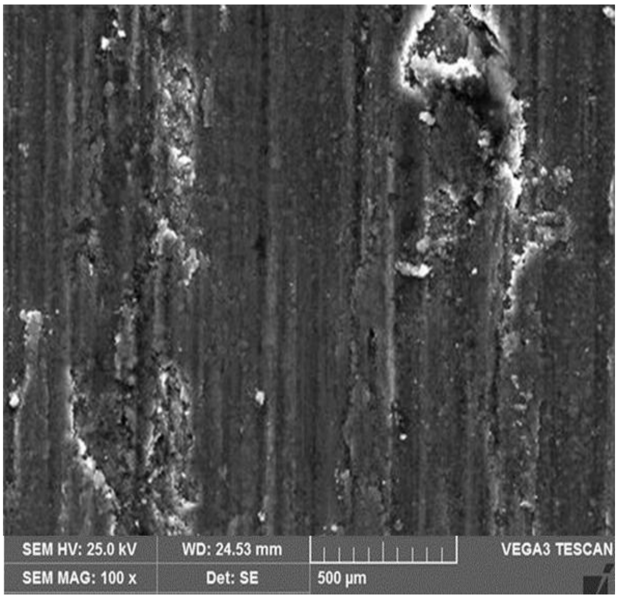
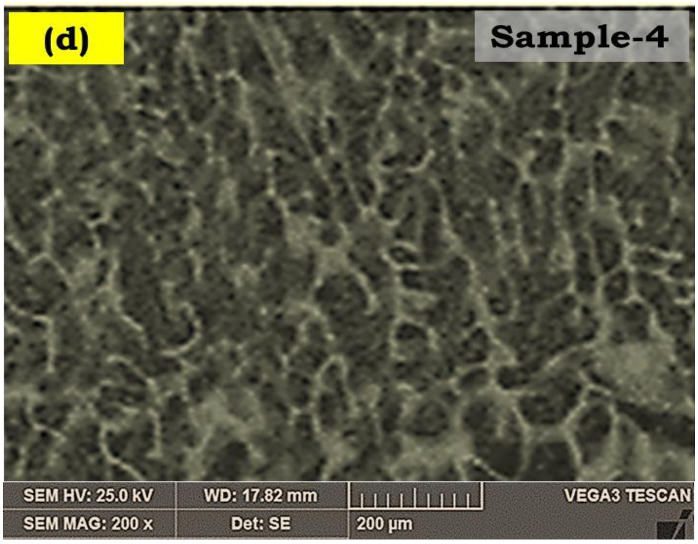
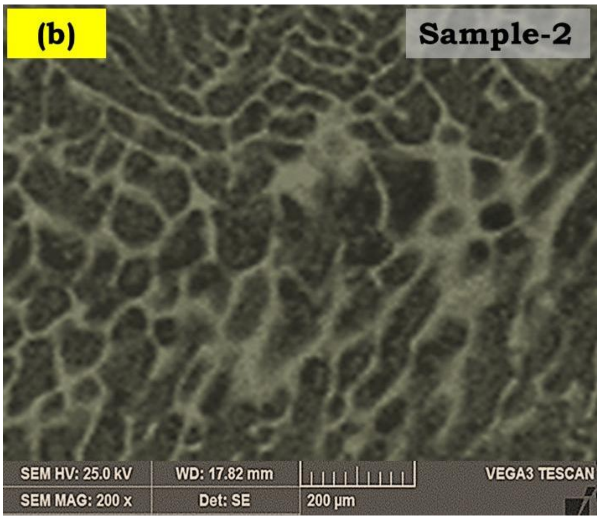
WD: 24.53 mm
VEGA3 TESCAN
SEM MAG: 100 x
Det: SE
500 µm


SEM HV: 25.0 kV
WD: 24.53 mm
VEGA3 TESCAN
SEM MAG: 100 x
Det: SE
500 µm


(d)
Sample-4
SEM HV: 25.0 kV
WD: 17.82 mm
VEGA3 TESCAN
SEM MAG: 200 x
Det: SE
200 µm


(b)
Sample-2
SEM HV: 25.0 kV
WD: 17.82 mm
VEGA3 TESCAN
SEM MAG: 200 x
Det: SE
200 µm

III. CONCLUSION AND FUTURE WORK

Summary of the present work

The AlSi10Mg alloy led to the results listed below,

In this study, the effects of addition of silicon and magnesium on the progression of the stage structure and microstructure of aluminum alloy produced using additive manufacturing were examined.

Additively created techniques focus on engineering metals from the perspective of the machine-driven solid products of the components, making it possible to employ them as widely as possible.

AlSi10Mg that has undergone selective laser melting might also have comparable Wear resistance to conventional processes.

Additive manufacturing is a manufacturing process which produces the desired part layer by layer.

The SLM process, a complicated replacement method that prints metallic components directly from CAD files which can be used.

Additive manufacturing is a growing field of engineering that allows for the production of complex goods without the use of conventional industrial course development

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