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Analysis of Effect of SiC Reinforcement on Microstructure and Hardness of Al 6061 and Al 7075

Katkar Ajit Ashok, Girish D. P. Koli, Gajanan Chandrashekhar

***Abstract:** In past few decades use of Aluminium Alloys and Aluminium Metal Matrix Composites have increased tremendously. Due to their light weight, corrosion resistance and excellent electrical and thermal conductivity they are fit many automotive and aeronautical applications. In this paper analysis of effect of SiC reinforcement on microstructure and hardness of Al 6061 and Al 7075 is presented. It is clearly evident that, addition SiC to base material changes its microstructural grain formation and size, uniform distribution of grain in the material will enhances mechanical properties. Also the hardness increases with increasing in weight percent of reinforcement composition..*

***Keywords:** Aluminium Alloys ,Microstructure, Hardness, Metal Matrix Composites*

I. INTRODUCTION AND LITERATURE REVIEW

Metal matrix composites are the composites made by metal with additional metal, ceramic or may be organic compounds. Improvement in mechanical properties is the ,main reason for which the reinforcements is done[1].According to Mathew et al.[2] Aluminum as a handy lightweight automotive material with considerable cost savings. They conducted milling trials on 6061 aluminum and derived a relationship between feed and surface quality. They carried a significant work to improve the productivity in milling operation of 6061 aluminum with respect to improvement in surface roughness and cycle time. In most of MMCs, Al-alloy-based composites are attracting the researchers around the world [3].

According to them depth of cut has a significant influence on cutting force, but an insignificant influence on surface roughness. Tulasiramarao et al. [4] carried out investigation on various forces such as cutting force, feed force and the axial force with the variation in speed for different materials like aluminum, brass, and mild steel. It has been observed that as the speed increases, the forces also increase up to certain limit and then decreases with any further increase in speed i.e., forces developed at 630 rpm are higher compared to 400 rpm and 1000 rpm.

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* Correspondence Author
Katkar Ajit Ashok *, Assistant Professor, Sanjeevan Engineering Technological University, Panhala, Kolhapur, India.
Dr. Girish D. P., Professor, Government Engineering College, Ramanagara, Karnataka, India .
Gajanan Chandrashekhar, Assistant professor, Sanjeevan Engineering Technological University, Panhala, Kolhapur, India .

Thamban et al[5] carried out machining of machining of 6061-T6 Aluminium alloys using diamond coated and uncoated tungsten carbide end mills under dry conditions. They found that diamond coating of the tools was performed using CVD process. According to Bonollo et al.[6] recent

foundry processes for Al-alloys, low pressure die casting has many benefits like elevated yield, exceptional control of operative parameters, fine metallurgical and technological quality.

II. METHODOLOGY AND EXPERIMENTAL DETAILS

For this stiudy two base materials Al 6061 and Al 7075. Are selected and SiC particle reinforcement is done using casting process. The details are shown in Table 1 and 2.

Table 1. Chemical composition of Aluminium 6061

Models	Reinforcements	
	Al 6061	SiC
1	100%	0%
2	98%	2%
3	96%	4%
4	94%	6%
5	92%	8%

The Al 6061 alloy with 200µm size SiC particles (reinforcement) are used for fabrication of MMC and Al 7075 alloy with SiC 200 µm size particles (reinforcement) are used for fabrication of MMCs. Al 6061 and Al 7075 ingots are melted in electrical resistance furnace and different weight percents silicon carbide reinforcement is added to get following composition composite specimens. The BHN is calculated according to the following formula:

$$B.H.N. = \frac{2*P}{\pi*D\left(D-\sqrt{D^2-d^2}\right)}$$

Where
BHN = the Brinells hardness number
P = the imposed load in kg

D = the diameter of the spherical indenter in mm

d = diameter of the resulting indenter impression in mm.

The measure hardness is shown in Table3.

Table 2. Chemical composition of Aluminium 7075

Models	Reinforcements	
	Al 7075	SiC
1	100%	0%
2	98%	2%
3	96%	4%
4	94%	6%
5	92%	8%

III. RESULT AND DISCUSSIONS

A. SiC and Hardness of Al 6061 and Al 7075

It is clearly evident that, addition SiC to base material changes its microstructural grain formation and size. Uniform distribution of grain in the material enhances mechanical properties. Figure 1 to 4 shows the microstructural evolution for the MMC. Partially equiaxed structure distributed over the material is found during investigation.

One significant aspect in microstructure observed in case of the SiC reinforced is presence of minute and rarely distributed porosity.

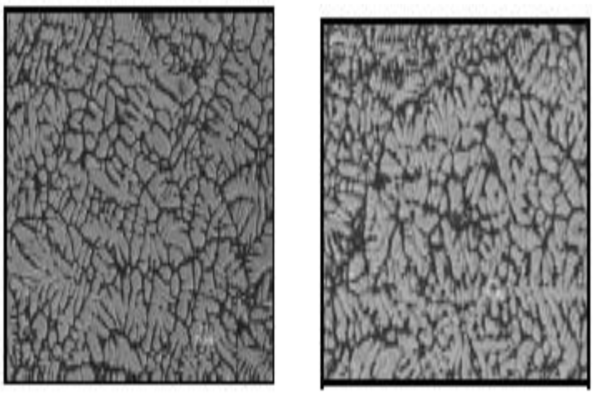

Fig. 1. Al-6061 with SiC 2% and 4%,

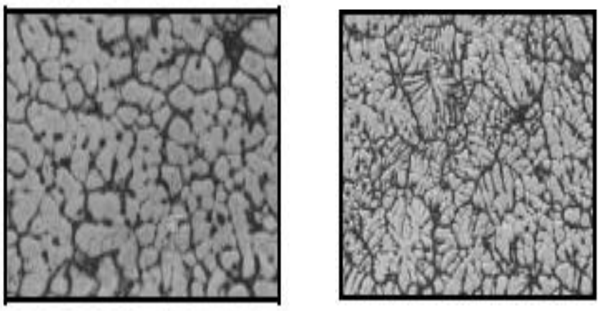

Fig. 2. Al-6061 with SiC 6% and 8%,

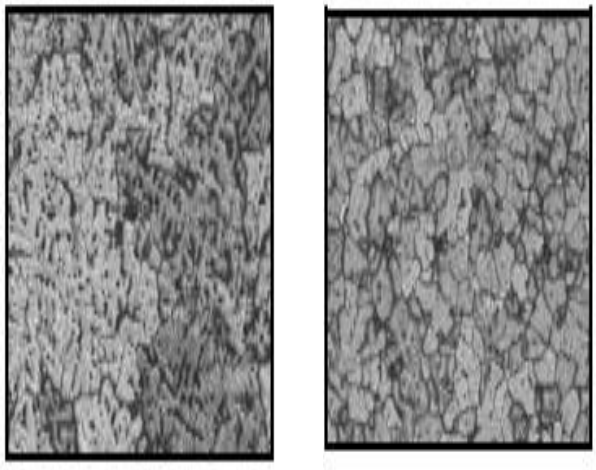

Fig. 3 Al-7075 with SiC 2% and 4%,

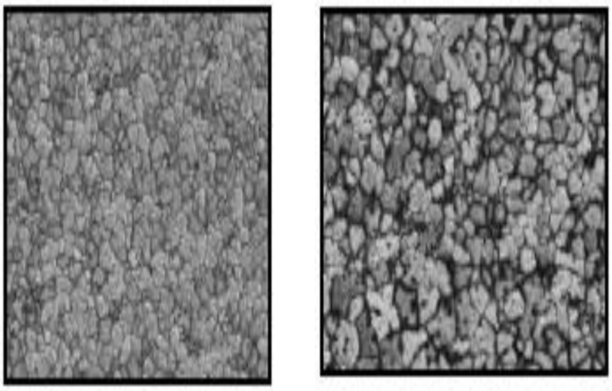

Fig. 4 Al-7075 with SiC 6% and 8%

From Figure 6.3 shows the hardness test results of Silicon Carbide reinforced with Al6061, in which 23% of hardness is increased from 0 to 8% weight of SiC with Al-6061, the specimen having highest BHN exhibits better hardness, this is due to silica content in the reinforcement will make the base material harder. From Figure 5 and 6 shows the hardness test results of Silicon Carbide reinforced with Al7075, in which 38% of hardness is increased from 0 to 8% weight of SiC with Al-7075, the specimen having highest BHN exhibits better hardness, this is due to silica content in the reinforcement will make the base material harder. Addition of reinforcement refines the grains structure, which strengthens material.

Table 3. Hardness of Al 6061 and Al 7075 MMCs

EN	Compositions	BHN			AVG BHN
		Trial 1	Trial 2	Trial 3	
1	Al6061+%0SiC	53.43	50.32	60.53	54.76
2	AL6061+2%SiC	60.53	64.61	64.61	63.25
3	Al6061+4%SiC	64.61	79.57	53.43	65.87
4	Al6061+6%SiC	53.43	64.06	74.07	67.52
5	Al6061+8%SiC	69.57	79.57	64.61	71.25
6	Al7075+0%SiC	69.10	74.07	74.07	72.41
7	Al7075+2%SiC	69.106	92.52	85.70	82.45
8	Al7075+4%SiC	79.57	100.24	92.56	97.67
9	Al7075+6%SiC	100.24	92.55	100.24	100.55
10	Al7075+8%SiC	92.55	100.89	118.73	104.05

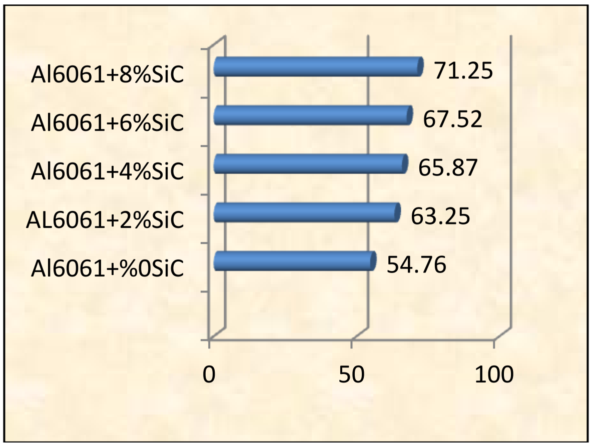

Fig. 5. Variation of SiC particulates on Al 6061

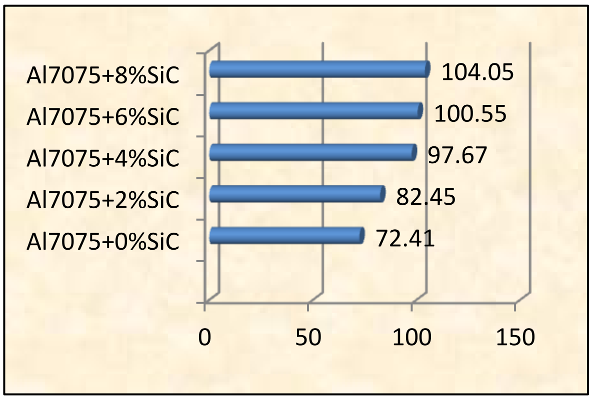

Fig 6 variation of SiC particulates on Al 7075

IV. CONCLUSION

It is clearly evident that, addition SiC to base material changes its microstructural grain formation and size. Uniform distribution of grain in the material enhances mechanical properties. Presence of minute and rarely distributed porosity is observed in microstructure.

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AUTHORS PROFILE

Katkar Ajit Ashok currently working as an assistant professor in Sanjeevan Engineering Technological University, Panhala. I have Teaching Experience of 11 yrs and Industrial Experience of 05 yrs. Also I am Pursuing Ph.D. in Mechanical Engineering from Visvesvaraya Technological University, Belagavi in the area of composite material.

Dr. Girish D.P., Professor at Government Engineering College, Ramanagara, Karnataka.My area of research is Composite Material. I am having Teaching Experience of 25 years and published 29 Research papers. Also I presented 11 International and 07 National conference Papers. Under my guidance 09 students have been awarded Ph.D..

Koli Gajanan Chandrashekhar working as an assistant professor in Sanjeevan Engineering Technological University, Panhala. I have 13 years teaching and 02 years industrial experience.Also I am Pursuing Ph.D. in Mechanical Engineering from Visvesvaraya Technological University, Belagavi in the Area of Composite Material.