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A B_4C composition and Micro structural study of Al-6061 Metal Matrix Composites Using SEM.

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Abstract: *The main subjective of the present works related to the material characterization of fabricated Al-6061 by stir casting technique as growing percentage by weight and the particle size of B_4C enhanced their strengthening effect and a distinct advantage is the quality to use many combinations of resins and reinforcements especially in aerospace industry. Furthermore, the effects of reinforced particles sizes on the microstructure of the composites were observed by using SEM. The best particles will provide more efficient barriers to dislocation flow in aluminum matrix and more homogeneously distributed. Bigger particles are more amenable to gravity settling and can result in agglomeration and accumulation of reinforcement in matrix realm in aluminum metal matrix composites.*

Keywords: *Particle Size, microstructure, Aluminum Metal Matrix Composites, Stir Casting Technique, Reinforcement.*

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I. Introduction

Aluminum alloy based ceramic material matter composites have been characteristic as futuristic materials are more preferred by engineers because of their great capability, low density, enhanced high refractoriness properties and dampness capabilities. (Gagandeep Singh et. al. 2019) have studied Al-B_4C based metal matrix composites that the fabricated Aluminium as AMMCs with percentage of increased B_4C the relative particle size and mechanical behavior under compressive strength can be accomplished [1]. (Gagandeep Singh et. al. 2019) have invested the compressive strength of Al-6061 based B_4C reinforced metal matrix composite and showing the better surface relation in between the matrix and the reinforced material by keeping the smaller particle size of B_4C. Therefore, the contribution of the percentage of B_4C is more significant than the particle size [2]. (Gagandeep singh 2018) have studied that in Al-6061 metal matrix composites were found to increase strength and stiffness to weight ratio. The fabricated composite may be used for light weight and high strength applications. In addition, ageing is found to increase the strength, micro and macro-hardness of the fabricated composites. The reinforced composite samples with different particle sizes of Al-6061 in μm were also made-up to further examine the surface characteristics. It is observed that the samples with small particle size exhibited agglomeration. The composites are fabricated by a simple and cost-effective stir casting technique and the results show that composites have higher modulus compared with the unreinforced alloy. The composites exhibit higher peak hardness and accelerated ageing compared with the unreinforced alloy. A 6061 AlB_4C -15% composite shows higher ultimate compressive strength compared with unreinforced Al Alloy at peak-aged condition. The composite containing Al-B_4C varying percentage by weight of B_4C particle size were fabricated. It is observed from Scanning electron microscopy that with the increase in percentage of the reinforced particle, the homogeneous and uniform distribution of metal in matrix of the composite material increases and thus the surface structure bonding is comparatively strong in this system as evidenced by the improved mechanical properties of these materials [3-6]. (Suresh R and M. Prasanna Kumar et. al. 2013) have experimented that the wear rate and coefficient of friction decreased linearly with increasing weight percentage of Al-6061. The wear rate increase as the sliding speed increases. The SEM of Aluminum 6061 composites produced by stir casting method shows that the fair uniform distribution of B_4C and Al-6061 particles in the metal matrix. The incorporation of Al-6061 and B_4C particles as reinforcements improved the tribological behavior and caused a reduction in the wear rate of Aluminum 6061 composites during the dry sliding process [10]. (B.Stalin.et.al 2017) deals with the fabrication of 5,10,15 wt % of boron carbide reinforced with aluminium alloy of metal matrix composite by using liquid stir casting technique was performed and fabricated for finding its tensile strength , hardness and impact strength and compare with base metal[14].(T.Murthy et.al. 2012) studied that aluminium matrix composites plays a vital role in advanced engineering materials due to their distinct mechanical properties like light weight, strength, wear, toughness, stiffness.etc.[15]. (Pramanik. et. al. 2016) has analyzed the wear parameters like sliding distance, pressure, sliding speed of Al-6061 composite.

A pin-on-disc wear machine was used for the wear study. A steel made disc was used. Investigated study shows that the composite used in this research work had much higher wear resistance as compared to corresponding matrix materials[8]. (Khalil et. al. 2012) reviewed the current developments on bamboo fibre based reinforced composites. The materials are utilized in composite as reinforcement was bamboo fibres. The bamboo fibre, which is stronger than other fibres were used as raw material in product designing and used for generating high quality sustainable products [4]. (H.C Anil kumar et. al. 2011) investigated mechanical properties of combination fly ash and aluminium alloy (Al-6061). The stir casting used for processing the samples. The size of particles are 4-25, 45-50 and 75-100 having three sets of composites are used. The mechanical properties were studied in this research. Also for the same properties, the unreinforced Al6061 samples were tested. By increasing the size of fly ash particle, decrease in mechanical properties of aluminium 6061 composite were found [3]. (Shao-Yun et. al. 2002) have experimented the tensile behavior of hard particle reinforced composite depends primarily on the type of interfacial bonding between the Al-matrix and the reinforcement. This is because of the strong interfacial bond which plays a critical role in transferring loads from the matrix to the hard particles. In case of heat treated alloy, the effective stress applied on the composite surface during wear process is less due to higher strength and ductility of the Al matrix. This resulted in less cracking tendency of the composite surface as compared to the cast alloy [13]. (Soon-chal et. al. 2006) The heat treatment did not radically change the morphology but hardening of the matrix by precipitation hardening took place, which led to higher hardness and strength. The conclusions made over the years by numerous investigators in the field of particle reinforced Al-MMCs. The mechanical properties were reviewed with respect to strength [12].

Sample Fabrication Methodology

The Stir casting mechanism has been developed by using vertical muffle furnace with graphite crucible the billet of Al-6061 alloy were preheated and the material is incorporated into the molten metal by stirring. This involves stirring the melt with ceramic particles of reinforced B_4C 5%, 10%, 15% by weight at different levels, and then allowing the mixture to solidify. This can usually be prepared by means of fairly conventional processing equipment and can be carried out on a continuous and semi continuous. The technology is relatively simple and low cost in order to fabricate the Al-MMC samples at least three pieces of each samples at different percentage by weight as per the standard specimen specifications [13].

II. Results & Discussion

3.1 Morphology studies

It has been observed that after going through the literature survey as much work is done on B_4C based Al-MMCs as compared with other based Al-MMCs. The microstructure of Al-6061 alloys and reinforcements particles of B_4C are fairly and uniformly distributed agglomeration of particles based composites and interface bonding between the matrix and reinforced particles are quite sharp indicating reasonably good bonding a Al-MMCs by varying weight percentages of morphology study has been obtained. As the density increases, the MMC becomes stiffer since the molecules do not have as much space to move around one another. Also as the molecular weight increases, the entanglement of the molecules resists movement. Along with reduction in porosity, a better distribution of particles was achieved in all alumina composites. The size, shape and texture of the initial well-structured silicon

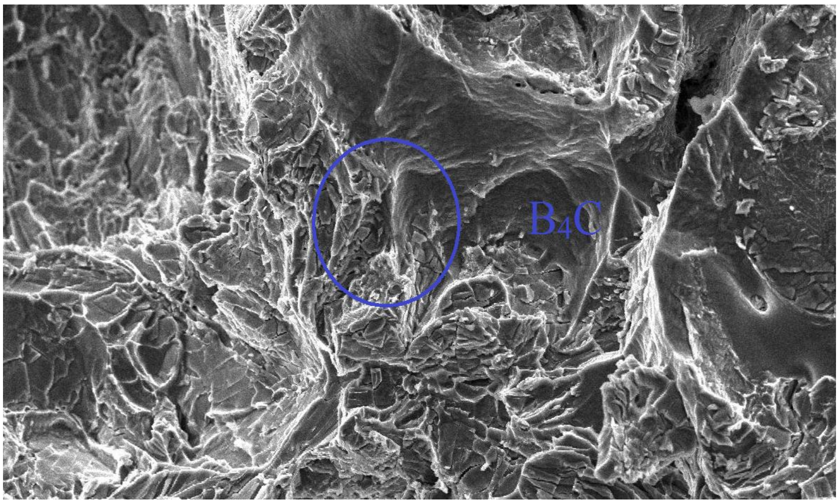

Figure 1. (a) At 50-mesh 5 % (wt.) of B_4C-AMMCs.

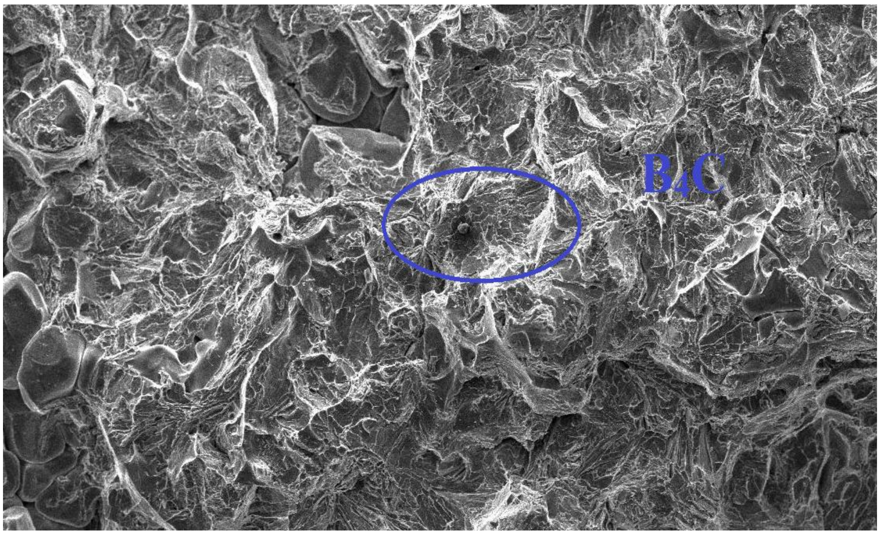

Figure 1. (b) At 100- mesh 5 % (wt.) of B_4C-AMMCs.

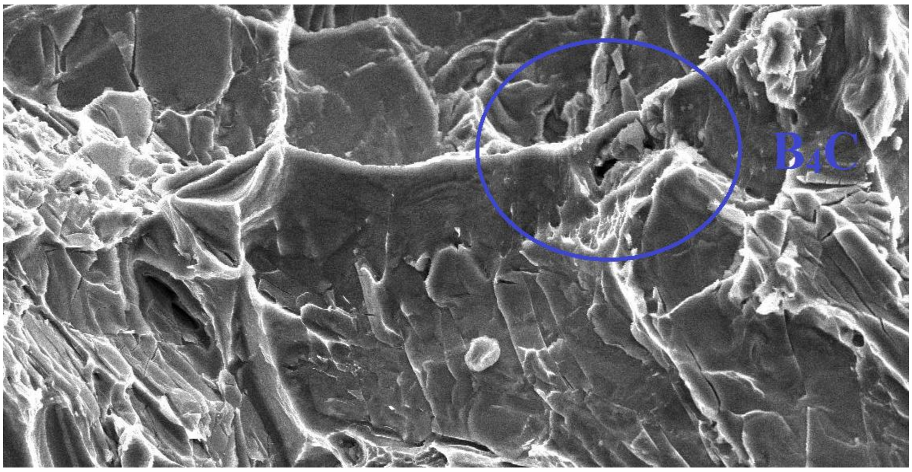

Figure 1. (c) At 150-mesh 5 % (wt.) of B_4C -AMMCs.

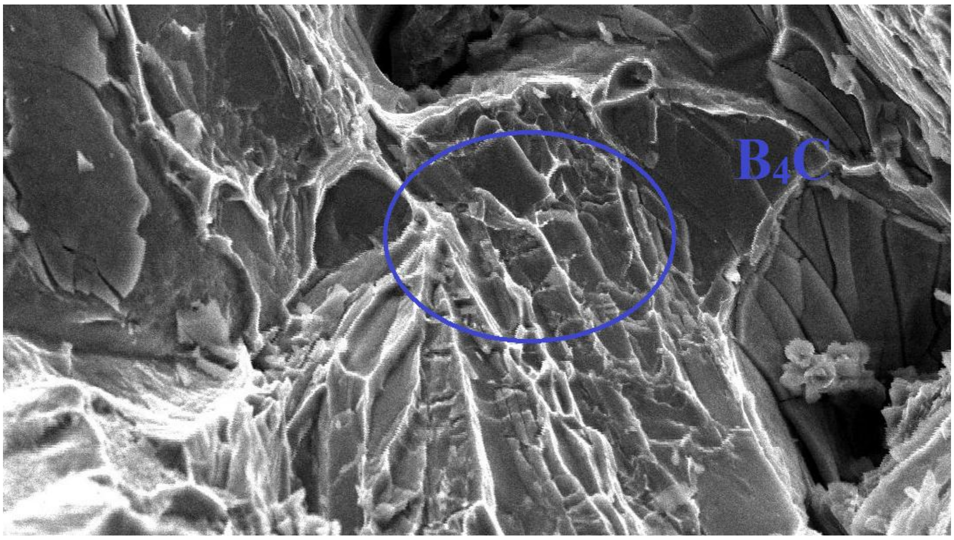

Figure 1. (d) At 50-mesh 15 (wt.) % of B_4C -AMMCs.

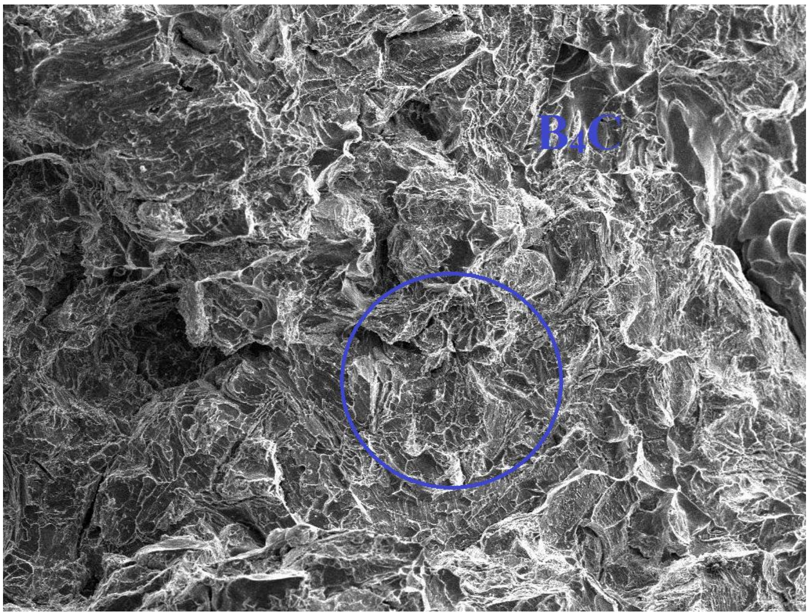

Figure 1. (e) At 100-mesh 15 (wt.) % of B_4C -AMMCs.

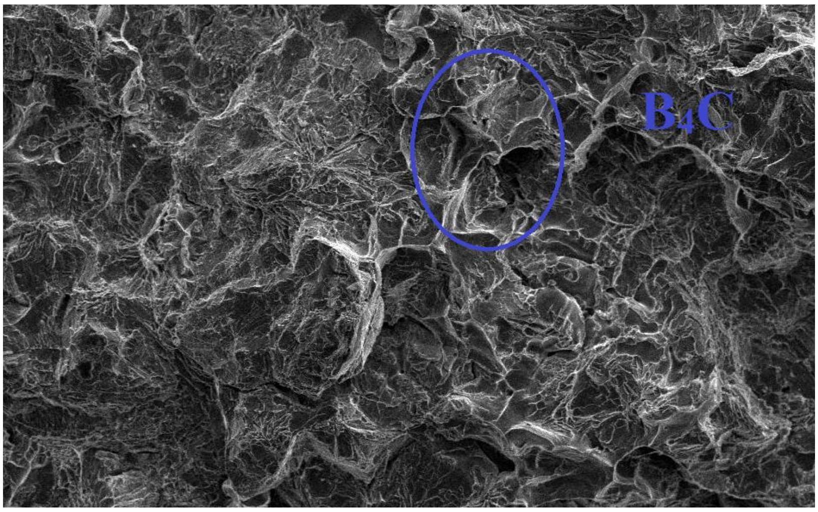

Figure 1. (f) At 150-mesh 15 (wt.) % of B_4C -AMMCs.

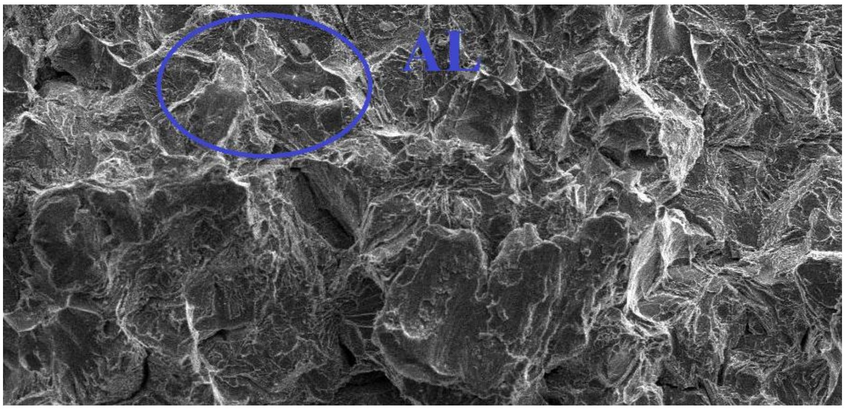

Figure 1.(g) AMMC of Al without B_4C

Under Scanning electron microscopy(SEM) (Model: SEM–JSM 6600) Relatively greater degree of Boron Carbide were studied using Secondary electron imaging mode of Scanning electron microscopy. SEM image of initial Boron carbide particles are mostly angular at 5% weight-age of reinforcement in shape. Here the angular structure of initial boron carbide has been destroyed and the flake shaped particles are observed with the increase at 15% of weight-age reinforcement of B_4C furthermore, the final shape of the particles is mostly sub-angular and the surface morphology is rough as shown in Figure 2 (a), (b), (c), (d) and (e) and (g)as shown in Figure. The SEM study shows that the addition of B_4C particles in different amount of sizes and varying percentage of particle sizes in the casting is also found to be observed the strengthening of composites particularly, at 10% of B_4C can be moderated in terms of dispersion strengthening due the reinforcements of part.

III. Conclusions

1. The present results shows that AMMCs casting development by stir casting method is cost effective method and to get uniform distribution of the reinforced particles and homogeneous properties can be achieved by using SEM .
2. The development of casted Al6061 that with increase in composition of B_4C of percentage and particle size at different has be investigated shows that smaller particle size will more fined structures as compared to large particle sizes..
3. Weight percentage of reinforcement is considered as primary parameter to control the mechanical properties.
4. The above figures shows the presence of B_4C in the base metal and the distinguish parent metal.

References

[1]. Gagandeep Singh, Ashwani kumar, 2019, "A review paper on stir casting of reinforced aluminium metal matrix composite (MMC), IJCET, Vol.9, No.3

[2]. Gagandeep Singh, Ashwani kumar, 2019, "Investigation of compression strength of al 6061 based B_4C reinforced meta matrix composite (MMC)", IJERS, DOI- V3.I1.05.2019.00023

[3]. Gagandeep Singh, 2018, "A fabrication and micro structural study of Al6061 Metal matrix composites , ARSEAM, vol.5.3. pp 01-07

[4]. Khalil HA, Bhat IU, Jawaid M , Zaidon A 2012, "Bamboo fibre reinforced biocomposites:Areview. Materials and Design", 42:353-68.

[5]. Nrip jit,Anand K. Tyagi, Nirmal Singh, 2006, "Evolution of metal casting (A review study)", Proceeding of International Conference on AME, 295-298.

[6]. Nripjit, Nirmal Singh, Anand K. Tyagi, 2007, "Development, processing and recent research of Al alloy composites", Proceedings of International Conference on Advanced Materials and Applications, Vol. 31,1-15.

[7]. Nrip Jit, Anand K Tyagi, Nirmal Singh, Dayal Chand, 2011, "Properties of (A384.1)1x [(SiC)p]x Composites by Keeping Particle Size at 0.220 μm", Proceedings of the World Congress on Engineering Vol 3, London, U.K.

[8]. Pramanik A. 2016, Effects of reinforcement on wear resistance of aluminium matrix composites. Transaction of nonferrous metals society of china .,26(2):348-58.

[9]. Shipra Verma, P.S. Rao 2018, "Study on mechanical behaviour of aluminium alloy 6061 based composite", IOSR-JMCE, DOI-10.9790/1684-1504031620.

[10]. Suresh R and M. Prasanna Kumar, 2013, "Investigation of tribological behavior and its relation with processing and microstructures of Al 6061metal matrix composites, IJRET, Vol.1 (2), 91-104.

[11]. Surappa MK and Rohatgi RK, 1981 "Preparation and Properties of cast aluminum ceramics particle composites" journal of Material Science, Vol. 16, 983-993.

[12]. Soon-Chul Kwon, Tadahrru adachi, Wakaka Araki, Akihiko Yamaji, 2006, "Thermovisco elastic properties of silica particulate-reinforced epoxy composites:Considered in terms of particle packing model ", Acta Materialia Vol. 54, 3369-3374.

[13]. Shao-Yun Fu, Guanshui Xu, Yiu-Wing Mai., 2002 " Study on the elastic modulus of hybrid particle/short-fiber/polymer composite", Composites: part B33, 291-299.

[14]. B.Stalin, 2017, " Mechanical properties of aluminium metal matrix reinforced with nano boron carbide", ANAS, 479-483.

[15]. T. Murthy, 2012, " Adhesive wear of aluminium alloy", Advance material research, vol. 622-623.