International Journal for Innovative Engineering and Management Research
A Peer Revieved Open Access International Journal
www.ijiemr.org

COPY RIGHT

ELSEVIER
SSRN

IJIEMR Transactions, online available on 28th Oct 2022. Link
:http://www.ijiemr.org/downloads.php?vol=Volume-11&issue=ISSUE-10

DOI: 10.48047/IJIEMR/V11/ISSUE 10/16

Title **INFLUENCE OF GRAPHITE IN METAL MATRIXCOMPOSITE FABRICATED BY STIR CASTING**

Volume 11, Issue 10, Pages: 132-138

Paper Authors
M Vimal Teja, Dr. Bazani Shaik ,Dr. M.Muralidhara Rao,B.Sudhakar Rao, J Sri-kanth , K Ravindranath , K Bhavanayana

USE THIS BARCODE TO ACCESS YOUR ONLINE PAPER

To Secure Your Paper As Per UGC Guidelines We Are Providing A Electronic Bar Code

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

INFLUENCE OF GRAPHITE IN METAL MATRIXCOMPOSITE FABRICATED BY STIR CASTING

M Vimal Teja[1] , Dr. Bazani Shaik[2] ,Dr. M.Muralidhara Rao[3] ,B.Sudhakar Rao[4], J Srikanth[5] , K Ravindranath[6] , K Bhavanayana[7]

[1] Associate Professor, Ramachandra College of Engineering, Eluru - 534007
[2, 3] Professor, Ramachandra College of Engineering, Eluru – 534007
[4,5,6,7] Assistant Professor, Ramachandra College of Engineering-534007

Abstract. Fiber reinforced Aluminum hybrid metal matrix composites have been widely used in automobile, aerospace and structural application because of their good tribological and mechanical properties. This work deals with the preparation of composites and evaluation of mechanical properties by introducing micro size reinforcement particle in the aluminum alloy. The reinforcement of Al alloy hybrid metal matrix composite with Al6061, B4C, Sic and Gr particles are produced by stir casting. After heat treatment process the casting materials are machined as per ASTM standard size. The mechanical properties such as tensile, hardness, impact test where conducted at room temperature. The mechanical properties are increased by increasing the weight percentage of reinforcement particles.

Keywords: Hybrid metal matrix composite, Aluminum, stir casting method, mechanical properties, Al6061, B4C, SiC& Gr.

1 Introduction

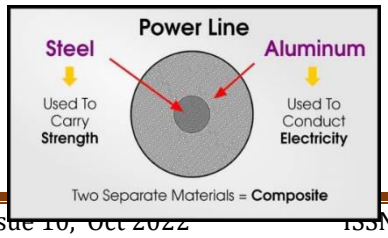
In general, the discontinuous phase is harder and stronger than the continuous phase and is called the 'reinforcement'; whereas continuous phase is termed as the 'matrix'. The matrix holds reinforcement to form the desiredshape and bears the major portion of an applied load, while the reinforcement improves overall mechanical properties of the matrix. Reinforcement increases the strength, stiffness, wear resistant and the temperature resistance capacity and lowers the density.

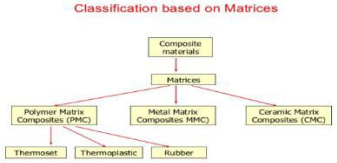
The term organic-matrix composite is generally assumed to include polymer Matrix composites (PMCs) and carbon matrix composites. The second classification refers to the reinforcement form; particulate reinforcements, whiskers, continuous fiber, laminated composites and woven composites.

Weight saving is one of the main reasons for using composite materials rather than conventional materials for components. While composites are lighter they can also be stronger than other materials, for example, reinforced carbon-fiber can be up to five times stronger than 1020 grade steel and only one fifth of the weight, making it perfect for structural purposes.

In recent years, aluminium alloy-based metal matrix composites (MMC) are gaining importance in several aerospace and automobile applications. But aluminium alloys having the low hardness and low strength compared to the other materials, so we choose the composition over the pure materials.

Why we choose aluminium over another materials aluminium was oftenly used material in the automobile shipping and another most industries so we choose aluminium as the matrix material





International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

Literature Review

Keshava Murthy R et.al studied about Al7075-TiB2 in-situ composite, processed by stir casting technique using commercially available Al-10%Ti and Al- 3%Br master alloys. Both matrix alloy and composite were subjected to microstructure analysis, micro hardness test, grain size studies and tensile test. Microstructure shows fairly uniform distribution of TiB2 particles in matrix alloy. Average grain size of the composite was lower than unreinforced alloy. Micro hardness, yield strength and ultimate tensile strength of Al7075-TiB2 composite, were considerably higher when compared with unreinforced alloy

Deepak Singla et al: He effectively created the Al 7075- fly fiery debris composites by utilizing mix casting course of action with legitimate conveyance of cinder particles all over the example. Moreover he included the Mg to make strides the wettability of fiery debris molecule by diminishing its surface pressure. He has given different conclusions from the different calculation based on the diff.exploratory testicles, he calculated the durability of the composites by utilizing izod and charpy tests. As the sum of fiery debris increments the sturdiness esteem continuously expanded up to a few level. Hardness and ductile quality of the composites moreover appeared the same comes about as like of sturdiness as the fortification was expanded. The thickness of the composites diminished with expanding cinder substance.

Anand Kumar et.al research work carried out by Addition of reinforcementsuch as TiC, SiC, Al2O3, TiO2, Tin, etc. to Aluminum matrix for enhancing themechanicalpropertieshasbeenawell-establishedfact.In-situmethodofreinforcementoftheAluminummatrixwithceramicphase-likeTitaniumCarbide(Tic)iswellpreferred over the Exist method. In the present investigation, Al- Cu alloy (series of2014 Aluminum alloy) was used as matrix and reinforced with TiC using In-situprocess. The Metal Matrix Composite (MMC) material, Al-.5%Cu/10%TiC developedexhib-itshigheryieldstrength,ultimatestrengthandhardnessascomparedtoAl-4.5%Cualloy. Percentage in-crease in yield and ultimate tensile strengths were reported to beabout15% and 24%.

Methodology and Experimental Work

Stir casting is a type of casting process in whicha mechanical stirrer is introduced toform vortex to mix reinforcement in the matrix material. It is a suitable process forproduction of metal matrix

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

composites due to its cost effectiveness, applicability tomassproduc-

6061AluminumAlloyCompositionbyMass%[4]

Al	Mg	Si	Fe	Cu	Cr	Zn	Ti	Mn	Remainder
95.85 - 98.56	0.8-1.2	0.40-0.8	0.0-0.7	0.15-0.40	0.04-0.35	0.0-0.25	0.0-0.25	0.0-0.15	0.05each, 0.15total

tion,simplicity,almostshapingandeasiercontrol ofcompositestructure.

Boroncarbidewellknownasaceramicmaterialwithrelativelyhighstrengthand durability as characterized by the relatively high values of its melting point, hardness,strength to density ratio, and wear resistance. B4C is third hardest material which followsbydiamond and cbn. Due to its high hardness, boron carbide powder is used as an abrasive inpolishingand lapping applications, and alsoas a loose abrasive incuttingapplicationssuchas water jet cutting. It can also be used fordressing diamond tools.Silicon carbide (SiC), also known as carborundum is a semiconductor containing silicon and carbon.

Results

S.NO	COMPOSITION

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

1	**Al6061 94%+B4C2%+2%SiC+Gr 2%**
2	**Al6061 90%+4%B4C+4%SiC+Gr 2%**
3	**Al6061 86%+6%B4C+6%SiC+Gr 2%**
4	**Al6061 82%+8%B4C+8%SiC+Gr 2%**

Table: Composition Names

Compositions	Trail1			Trail2			VHN
	D1	D2	VHN	D1	D2	VHN	
Al6061 94%+B4C2%+2% SiC+Gr 2%	78	88	290	67	76	296	293
Al6061 90%+4%B4C+4% SiC+Gr 2%	67	76	302	87	87	306	304
Al6061 86%+6%B4C+6% SiC+Gr 2%	89	76	325	67	67	326	325.5
Al6061 82%+8%B4C+8% SiC+Gr 2%	87	86	340	79	57	345	342.5

Table: Hardness Values

Compositions	Trail1			Trail2			VHN
	D1	D2	VHN	D1	D2	VHN	
Al6061 94%+B4C2%+2% SiC+Gr 2%	87	79	310	89	96	312	311
Al6061 90%+4%B4C+4% SiC+Gr 2%	76	67	323	98	94	345	334
Al6061 86%+6%B4C+6% SiC+Gr 2%	68	89	344	95	93	343	343.5
Al6061 82%+8%B4C+8% SiC+Gr 2%	59	67	357	96	92	356	356.5

Table: Heat Treatment of Water

Compositions	Trail1			Trail2			VHN
	D1	D2	VHN	D1	D2	VHN	

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

Al6061 94%+B4C2%+2% SiC+Gr 2%	69	79	337	78	67	341	339
Al6061 90%+4%B4C+4% SiC+Gr 2%	78	89	376	79	78	383	379.5
Al6061 86%+6%B4C+6% SiC+Gr 2%	79	98	397	67	90	403	400
Al6061 82%+8%B4C+8% SiC+Gr 2%	87	67	410	79	89	412	411

Table: Heat Treatment of ICE

S.no	Material	Initial weight	Finalweight	Lossofweight
1	**Al6061 94%+B4C2%+2%SiC+Gr 2%**	14.675	14.65	0.074
2	**Al6061 90%+4%B4C+4%SiC+Gr 2%**	15.876	15.876	0.068
3	**Al6061 86%+6%B4C+6%SiC+Gr 2%**	14.864	14.864	0.063
4	**Al6061 82%+8%B4C+8%SiC+Gr 2%**	15.897	14.675	0.056

Table: Wear at 1Kg load 200mts

S.no	Material	Initial weight	Finalweight	Lossofweight
1	**Al6061 94%+B4C2%+2%SiC+Gr 2%**	14.464	14.464	0.089
2	**Al6061 90%+4%B4C+4%SiC+Gr 2%**	13.567	13.567	0.081
3	**Al6061 86%+6%B4C+6%SiC+Gr 2%**	14.345	14.345	0.079
4	**Al6061 82%+8%B4C+8%SiC+Gr 2%**	14.434	14.434	0.071

Table: Wear at 1Kg load 400mts

International Journal for Innovative Engineering and Management Research
PEER REVIEWED OPEN ACCESS INTERNATIONAL JOURNAL
www.ijiemr.org

S.no	Material	Initial weight	Finalweight	Lossofweight
1	**Al6061 94%+B4C2%+2%SiC+Gr 2%**	14.575	14.575	0.913
2	**Al6061 90%+4%B4C+4%SiC+Gr 2%**	15.675	15.675	0.891
3	**Al6061 86%+6%B4C+6%SiC+Gr 2%**	14.786	14.786	0.785
4	**Al6061 82%+8%B4C+8%SiC+Gr 2%**	14.567	15.567	0.657

Table: Wear at 1Kg load 600mts

Conclusion

- TheAL6061-B_4C-sic-gr AND Sic metalmatrixcompositematerials havebeenfabricatedby stir castingmethodfollowedby extrusionprocess Fabricated process further subjected to various testing's
- The B_4C, Sic and sic particulates are evenly dispersed in the matrix alloy. The microhardness of AL6061- B_4c–sic- Gr metal matrix composite material is superiorthanthematrixmaterial which is less than previously fabricated AL6061- B_4c–sic
- As the percentage of reinforcement increases than the hardness also increased, by the addition of graphite hardness decreased
- With the results of hardness comparatively less than without graphite of same compositions.
- There was decreases of hardness 16% of in every composites with addition of graphite due graphite having machinability property
- Further compents subjected to the heat treatment process in order improve all the properties in different mediums like water, oil and ice.
- As the composites are subjected to the heating the upto 230^{o}cin the muffle furnace and subjected to soaking for 2 hours
- In order to check the frictional behavior of composites it was further subjected to load conditions by the pin on disc.to evaluate the results of the here it self-taken different speeds, rpm and load

References

[1] T.Raja,O.P.Sahu.,EffectsonMicrostructureandHardnessofAl-B4CANDSICMetalMatrixCompositeFabricatedthroughPowderMetallurgy,InternationalJournalofMechanicalEngineering,Global ScienceResearch Journals,March,2014,pp.001-005

[2] ManickamRaviChandranetal.,InvestigationsonPropertiesofAl-B4CANDSICComposites Synthesized throughPowderMetallurgyRoute, AppliedMechanicsandMaterials,Vol.852, 2016,

[3] T. Varol, A. Canakci., Synthesis And Characterization Of Nanocrystalline AL6061–B4C AND SIC Composite Powders By Mechanical Alloying, philosophicalMagazineLetters., 2013,Vol. 93, PP.339–345.

[4] Cun-Zhu Nie et al., Production of Boron Carbide Reinforced 2024 AluminumMatrixCompositesbyMechanicalAlloying,MaterialsTransactions,Vol.48,2007,PP. 990 – 995.

[5] ShubhranshuBansalandJ.S.Sain.,MechanicalAndWearPropertiesOfB4CANDSIC/Graphite Reinforced Al359 Alloy-Based Metal Matrix Composite, DefenseScienceJournal, Vol.65,No. 4, July 2015,PP.330-338.
[6] P. Ravindran et al., Tribological properties of powder metallurgy – Processedaluminium lubricating hybrid composites with B4C AND SIC additions, MaterialsandDesign, 2013, PP.561–570.
[7] N. Senthil Kumar et al., Mechanical Characterization An Tribological Behavior OfAl-Gr-B4CANDSICMetalMatrixCompositePreparedByStirCastingTechnique, Journal of Advanced Engineering Research, Volume 1, Issue 1, 2014,PP.48-59.
[8] N. G. Siddesh Kumar et al., Dry Sliding Wear Behavior of Hybrid Metal MatrixComposites, International Journal of Research in Engineering and Technologyvolume03SpecialIssue03, May, 2014, PP. 554-558.
[9] T. Thirumalai et al., Production and characterization of hybrid aluminum matrixcompositesreinforcedwithboroncar-bide(B4CANDSIC)andgraphite,Journalofscientific&industrialresearch,2014,PP.667-670.
[10] P. Ravindran et al., Tribological properties of powder metallurgy –Processed aluminums lubricating hybrid compo-sites with B4C ANDSICadditions,Materialsand Design,2013,pp. 561–570
[11] S.Mahdavi,F.Akhlaghi,FabricationandcharacteristicsofAl6061/B4CANDSIC/Grhybridcompositesprocessedbyinsitupo wdermetallurgymethod,Journalof CompositeMaterials,2012,PP.437–447.
[12] S.Suresha,B.K.Sridhara.,Effectofadditionofgraphiteparticulateson thewear behavior in Al-B4C AND SIC-Gr compo-sites, Mater Des.,2010, PP.1804–1812.
[13] S. Basavarajappa et al., Dry sliding wear behavior of Al2219/B4CAND SICp–Grhybrid metal matrix composites, J Mater Eng Perform,2006, PP.668–74.
[14] K.SunilRatnaKumaretal.,EvaluationofMechanicalbehaviourofPowder Metallurgy-ProcessedAluminiumSelfLubricatingHybridComposites with B4 C and Gr Additions, IJRMET Vol. 6, Issue 1, Nov2015-April2016, PP.120-127.
[15] Ch.Ratnam,K.SunilRatnaKumar.,CorrosionBehaviourofPowderMetallurgyProcessedAluminiumSelf-LubricatingHybridMetalMatrixCompositeswithB4CANDSICandGrAdditions,SSRG-IJME,SpecialIssueMay,2017,PP.279-290.
[16] GangadharaRao, P.,GopalaKrishna,A.,Vundavalli,P.R.,ParameteroptimizationofAl-SiCmetalmatrixcompositesproducedusingpowder-basedprocess,(2015) Proceedings of 2015 International Conference on Robotics, Automation, Control and EmbeddedSystems,RACE2015,art.no.7097265
[17] FakruddinBabavali, Sk., Sarma Nori, T., Srinivasu, Ch.Analytical study of thermo acoustical excess parameters and Redlich-Kister coefficients in functional materials at known four temperatures range from 303.15 K to 318.15 K.(2021) Materials Today: Proceedings, 46, pp. 369-375.
[18] Bazani Shaik, Parametric Optimization by Using Friction Stir Processing, AIP Conference Proceedings 2395, 030010 (2021); https://doi.org/10.1063/5.0068218, Published
[19] Bazani Shaik, Investigations on Microstructures by using Friction Stir Processing, Intelligent Manufacturing and Energy Sustainability, Smart Innovation, Systems and Technologies 265, (2022) https://doi.org/10.1007/978-981-16-6482-3_53.
[20] Bazani Shaik, Investigations on Different Parameters by Using Friction Stir Processing, Stechnolock Archives of Material Science, 2021, 1:1-13.,Online: 18 October 2021.