

MECHANICAL CHARACTERISATION ON SILICON CARBIDE CARBON POWDER, ALUMINIUM METAL MATRIX COMPOSITE FOR ROBOT GRIPPER APPLICATION

Submitted in partial fulfillment of the requirements for the award of
Bachelor of Engineering degree in Mechanical engineering.

by

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MARCH – 2021

DECLARATION

We ALAN SHAJI LUKOSE(37150008) and ABY MAMMEN VARGHESE (37150003) hereby declare that the Project Report entitle “**MECHANICAL CHARACTERISATION ON SILICON CARBIDE CARBON POWDER ALUMINIUM METAL MATRIX COMPOSITE FOR ROBOT GRIPPER APPLICATION**” done by us under the guidance of **Dr.R.B.DURAIRAJ M.E. Ph.D.**at **SATHYABAMA Institute Of Science and Technology**, Chennai is submitted in partial fulfilment of the requirements for the award of Bachelor of Engineering degree in Mechanical engineering

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of ALAN SHAJI LUKOSE (37150008), ABY MAMMEN VARGHESE (37150003) who carried out the project entitled “**MECHANICAL CHARECTERISATION ON SILICON CARBIDE CARBON POWDER ALUMINIUM METAL MATRIX COMPOSITE FOR ROBOT GRIPPER APPLICATION**” under our supervision from October 2019 to April 2020.

Internal Guide

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Submitted for Viva voce Examination held on _____

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ACKNOWLEDGEMENT

I am pleased to acknowledge my sincere thanks to Board of Management of SATHYABAMA for their kind encouragement in doing this project and for completing it successfully. I am grateful to them.

I convey my thanks to **Dr.S.PRAKASH. M.E. PhD**, Dean, School of Mechanical engineering and **Dr.G.ARUNKUMAR, M.E. PhD**, Head of the Department, Dept. of Mechanical engineering for providing me necessary support and details at the right time during the progressive reviews.

I would like to express my sincere and deep sense of gratitude to my Project Guide **Dr.R.B.DURAIRAJ, M.E. PhD**, for his valuable guidance, suggestions and constant encouragement paved way for the successful completion of my project work.

I wish to express my thanks to all Teaching and Non-teaching staff members of the Department of Mechanical engineering who were helpful in many ways for the completion of the project.

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ABSTRACT

Composite Materials are shaped by at least two unmistakable metals to accomplish the unrivalled physical and mechanical properties, to improve the cutting edge designing applications and modern requirements. These necessities can be filled by the Metal Matrix Composites. Aluminium matrix composites (AMCs) allude to the class of light weight and superior aluminium driven material frameworks. The fortifications like Al₂O₃ and SiC in volume parts going from a couple of percent to 60% in AMCs could improve the properties of this metal. Among them silica carbide (SiC) particles have been found to have an incredible similarity with the aluminium lattice and can be acquired requiring little to no effort. This likewise fulfils the buyers' requests like lightweight material, ease powerful, less creation cost, higher adaptability with significant strength. Presently the Aluminium Metal Matrix Composites are generally utilized and furthermore fresher advancements are made to get light-weight, high strength, high solidness and the necessary properties. This paper gives the outline conversation about the assembling of Aluminium Metal Matrix Composite, producing measures with related benefits and impediments.

LIST OF SYMBOLS AND ABBEREVIATIONS

AMC	Aluminium metal matrix composite
SiC	Silicon carbide
SEM	Scanning electron microscopy
XRD	X-Ray Diffraction
FTIR	Fourier Transform Infrared Spectroscopy

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CHAPTER 1

1)INTRODUCTION ON METAL MATRIX COMPOSITE

1.1) CHARECTERIZATION:

Metal Matrix Composite materials are shaped by the consolidating a particular component or metal with another natural or fired material with a folio to get the improved mechanical properties than the ordinary materials. The framework is the overwhelming material which gives the state of the composites and moves the heap between the metal and support. A more grounded material in the composite is called reinforcement. It conveys in general in the grid material. In MMC producing, specifically cases folio is additionally used to make the hold between the framework and support by both precisely and artificially. The composite property may shift as indicated by the size, shape, circulation, and morphology and grid pieces. These composites have light weight with more strength. By choosing the appropriate blend of metal framework and support material, we will have the option to accomplish the ideal application properties specifically application. Metal framework gives pertinent properties including explicit strength, high young's modulus, specific stiffness, wear resistance, corrosion resistance, elastic modulus, high thermal and electrical conductivity

1.2) APPLICATION:

Aluminum framework composites (AMCs) are the new age materials that can achieve the current interest of many designing applications, including auto and submerged segments, protection apparatuses, structure components, and so forth. In the last two thirty years, AMC turns into the most encouraging ones because of their mechanical and logical benefits like high weight to strength proportion, higher malleability, and toughness than artistic composites, higher power and temperature capacity than polymer composites, higher strength/weight proportion, and erosion opposition than steel. The metal grid composites have the most huge properties as contrast with the unadulterated metals/compounds. Aluminium is lighter than different metals like titanium, magnesium, and showed a principal interest in numerous applications. The future interest in AMCs; is a direct result of minimal effort and less thick fortifications present in it. Among the unique kinds of AMCs, broad examination has stretched out to deliver Al/SiC composites. These materials show numerous applications in vehicle and aviation businesses because of higher strength/weight proportion, lower composite thickness, higher wear obstruction.

1.3) PREPERATION:

Aluminium–silicon amalgams are the most well known in the rundown of cast aluminum combinations. The astounding castability, high thermal conductivity, low density, and high corrosion resistance of this combination make it an option for the cast iron in auto segments. The high temperature, pressure, and sliding movement inside the cylinder chamber course of action requests to improve the strength and wear resistance. Be that as it may, low wear resistance, hardness, and strength limit these amalgams in explicit applications like cylinder, chamber liner, and chamber head manufacture. The incorporation of fired materials into aluminium amalgams brings about new material with unrivaled properties than unreinforced aluminium composites. The earthenware production materials, attempted by different analysts, incorporate the silicon carbide (SiC), boron carbide, aluminium oxide, TiC, WC, and so on Among these, the incorporation of SiC in Al–Si amalgam detailed the apparent enhancements in a few alluring properties contrasted and the solid aluminium amalgam. Concurring to Lee et al., the hardness, strength, and wear résistance have been improved altogether with SiC incorporation in the Al-10Si and Al-12Si aluminium combinations. The creators have noticed the decreased mass lost with the consideration of SiC than that of unreinforced amalgam. Additionally, the mass loss decreases with expanding the reinforcement substance, furthermore, the base worth is gotten in Al-20%SiC composite. Comparable outcomes were accounted

for by Walczak et al. In another examination, Prasad et al. have seen that AlSiC-RHA hybrid composites showed better wear resistance than the Al–SiC composite and unreinforced solid Al–Si amalgam. The significant limit of AMCs; is the deficiency of ductility that builds the machining cost of the material. Additionally, the expansion of unfamiliar particles in the base grid changes its microstructure that causes an immediate or aberrant impact on the materialistic properties. In another exploration, Zhu et al. played out a relative report on the Al–SiC Nano composites. Creators detailed that press projecting, in types of grain refinement and improved mechanical conduct, gives better results than customary mix projecting. A comparable near study was likewise performed by Venkatesan and Xavier . The creators reasoned that mix projecting and crush projecting measures perform similarly comparable to improving the pliable conduct of graphene built up aluminium network composites. Likewise, the composites containing graphene substance up to 0.3 wt% show uniform appropriation of support particulates with no grouping. In another exploration, it has been seen that utilizing steel as a support in aluminium grid composites performs better as hardness, rigidity, crack durability, and so forth than SiC built up composites.

CHAPTER 2

LITERATURE SURVEY:

- a) Influence of activated carbon particles on microstructure and thermal analysis of AA7075 metal matrix composites
By (G.Ramanan, J . Edwin Raja Dhas, M.Ramachandran and G. Diyu Samuel)
- b) Relative examination on the mechanical , tribological , morphological and structural properties of vortex projecting cycle , Al-SiC-Cr half breed metal grid composite for high strength wear – opposition application : Fabrication and characterization by (Jatindar kumar,Dilbag singh,Nirmal s kalsi , Subham sharma)
- c) Manufacturing process and recent applications of aluminium matrix composite materials by (S Senthil, M Raguraman , D Thamarai Manalan)
- d) Wear behaviour analysis of silica carbide based aluminium metal matrix composite by (Ratna Deepika Manikonda , Arul Raj K , Sateesh N)
- e) Microstructure and mechanical behaviour of Al/SiC/Al₂O₃ hybrid metal matrix composite by (Sashi Prakash , Ashis Kumar)

f) Aluminum based metal matrix composites (AMMCs) have the potential for supplanting regular solid materials because of astounding fatigue, creep and wear resistance, high temperature maintenance, and high solidarity to weight proportion. In this way Aluminium based metal framework composites have a few applications in various enterprises including Aerospace and Automotive. This examination uncovered that Al 6063 based metal lattice composites built up with Al_2O_3 , SiC, TiO_2 have higher hardness, elasticity, and yield strength when contrasted with the unadulterated Al 6063. This examination shows that hardness, elasticity, and yield strength are expanding as expanding SiC particles content. Microstructure and surface morphological investigations have been done to see their surface and particles dissemination. Energy Dispersive X-beam Spectroscopy (EDS) and XRD investigation have been led to recognize components content. Fourier Transform Infrared Spectroscopy (FTIR) investigation is completed to recognize synthetic utilitarian gathering of the Al6063 metal framework composites. By (M. A. Chowdhury, B.K. Roy, A. Rahman)

g) Powder metallurgy is a material handling procedure to deliver novel parts and segments by utilizing different metal powders as beginning materials through the mixing, compaction and sintering measure. It is a prestigious, prudent cycle for making complex parts with close to net

shapes. It is more beneficial than other metal framing strategies. It prompts produce parts with perplexing shape at less expensive cost. Moreover, it can possibly create adaptable parts and keep up part to part consistency with improved surface quality. This innovation is profoundly applied in aviation, vehicle businesses, and for underlying applications. In this exploration work, manufacture of Al-SiC composite by powder metallurgy strategy is talked about. The support was homogenously disseminated in the lattice stage with no development of results. SiC particles with various structures (10 and 20 wt%) were added as support. Additionally, the option of SiC in the network framework improves mechanical properties of composites. After the improvement of material, the hardness, thickness and porosity of the composites have been assessed. By (S. Ram Prakash, K. Bravilin Jiju).

- h) The economy is huge component these days on the lookout. The analyses are accepting a huge occupation in building field to grow the existence of machine parts/portions and decreasing the cost. The composite materials can replace comprehensively used steel and aluminium due to their extraordinary characteristics with better execution. Today, aluminium is utilized unreasonably across a wide scope of areas, including homegrown, transportation, land, ocean, air and industry. Aluminium can be utilized absolutely or as a combination by consolidating it with an assortment of different components like copper, magnesium, manganese, silicon and zinc and so on Every

component gives the compound various qualities and its creation varyingly affects the amalgam's mechanical properties. Morphological examinations of Al, SiC and Fe by SEM. The current assessment relies upon examination of the effect of particulate stage on Micro hardness, Modulus of Elasticity and wear qualities of Al as base material and Silicon Carbide and Ferrous as support composites. The microhardness and Elastic Modulus of the example is expanded from 63 to 71 and 687 MPa to 720 MPa separately with expanding the level of silicon carbide from 5 to 15%. The various results incited from the tests are explored and presented to connection with each other in this assessment. By (Rakesh Kumar Yadav, Zahir Hasan, Husain Ansari).

- i) A few Al/SiC MMCs having a few volume portions up to 15 vol.% and distinctive SiC particulates normal sizes, ordinarily, 11, 6 and 3 μm were manufactured utilizing traditional powder metallurgy course. The impact of the size and volume part of SiC particulates on the microstructural and erosion conduct of Al/SiC metal grid composites (MMCs) were considered. The outcomes uncovered that the Al/SiC MMCs displayed higher thickness than unadulterated Al lattice. The static inundation erosion trial of Al/SiC MMCs in 3.5 wt.% NaCl fluid arrangement at a few temperatures showed that, at encompassing temperature, the Al/SiC MMCs have preferred consumption obstruction over the unadulterated Al network. Lessening the SiC particles size or potentially expanding the volume

part of the SiC particulates reduce(s) the erosion pace of the Al/SiC MMCs. Interestingly, the Al/SiC composites showed higher consumption rates at 50 °C and 75 °C than the unadulterated Al grid. By (H. M. Zakariya).

A union of powders utilizing the KOBO technique at raised temperature was expounded for creation of Al/SiC metal grid composite (MMC). The perceptions of the mean strain and inelastic strain range during the power controlled high cycle exhaustion (HCF) tests distinguished the tightening component joined with instrument portrayed by cyclic versatility. Harm boundaries were determined based on strain signal procurement during weakness tests. Exhaustion properties, creep opposition and lifetime of Al/SiC MMC were bit by bit improved with the increment of the SiC particles content. The microstructural perceptions of the material when tests were additionally performed. By (K. Pietrzak, LDietrich, K Makowska).

CHAPTER 3

3)COMPONENTS;

3.1) physical Properties of Aluminium

3.1.1) Density of Aluminium

Aluminium has a density around 33% that of steel or copper making it one of the lightest financially accessible metals. The resultant high solidarity to weight proportion makes it a significant primary material permitting expanded payloads or fuel reserve funds for transport enterprises specifically.

3.1.2) Strength of Aluminium

Unadulterated aluminium doesn't have a high tensile strength. Be that as it may, the expansion of alloying components like manganese, silicon, copper and magnesium can build the strength properties of aluminium and produce a composite with properties custom fitted to specific applications.

Aluminium is appropriate to cold conditions. It has the benefit over steel in that its rigidity increments with diminishing temperature while holding its toughness. Steel then again gets fragile at low temperatures.

3.1.3) Corrosion Resistance of Aluminium

At the point when presented to air, a layer of aluminium oxide shapes immediately on the outside of aluminium. This layer has superb protection from corrosion. It is genuinely impervious to most acids yet less impervious to soluble bases.

3.1.4) Thermal Conductivity of Aluminium

The thermal conductivity of aluminium is around multiple times more prominent than that of steel. This makes aluminium a significant material for both cooling and heating applications, for example, heat-exchangers. Joined with it being non-poisonous this property implies aluminium is utilized broadly in cooking tools and kitchenware.

3.1.5) Electrical Conductivity of Aluminium

Alongside copper, aluminium has an electrical conductivity sufficiently high for use as an electrical conductor. Albeit the conductivity of the normally utilized leading amalgam (1350) is just around 62% of toughened copper, it is just a single third the

weight and can accordingly direct twice as much power when contrasted and copper of a similar weight.

3.1.6) Reflectivity of Aluminium

From UV to infra-red, aluminium is a brilliant reflector of brilliant energy. Visible light reflectivity of around 80% methods it is generally utilized in light installations. Similar properties of reflectivity makes aluminium ideal as a protecting material to ensure against the sun's beams in summer, while protecting against heat misfortune.

Property	Value
Atomic Number	13
Atomic Weight (g/mol)	26.98
Valency	3
Crystal Structure	FCC
Melting Point (°C)	660.2
Boiling Point (°C)	2480
Mean Specific Heat (0-100°C) (cal/g.°C)	0.219
Thermal Conductivity (0-100°C) (cal/cms. °C)	0.57
Co-Efficient of Linear Expansion (0-100°C) ($\times 10^{-6}/^{\circ}\text{C}$)	23.5
Electrical Resistivity at 20°C ($\Omega\cdot\text{cm}$)	2.69
Density (g/cm ³)	2.6898
Modulus of Elasticity (GPa)	68.3
Poissons Ratio	0.34

TABLE 1



FIG-1

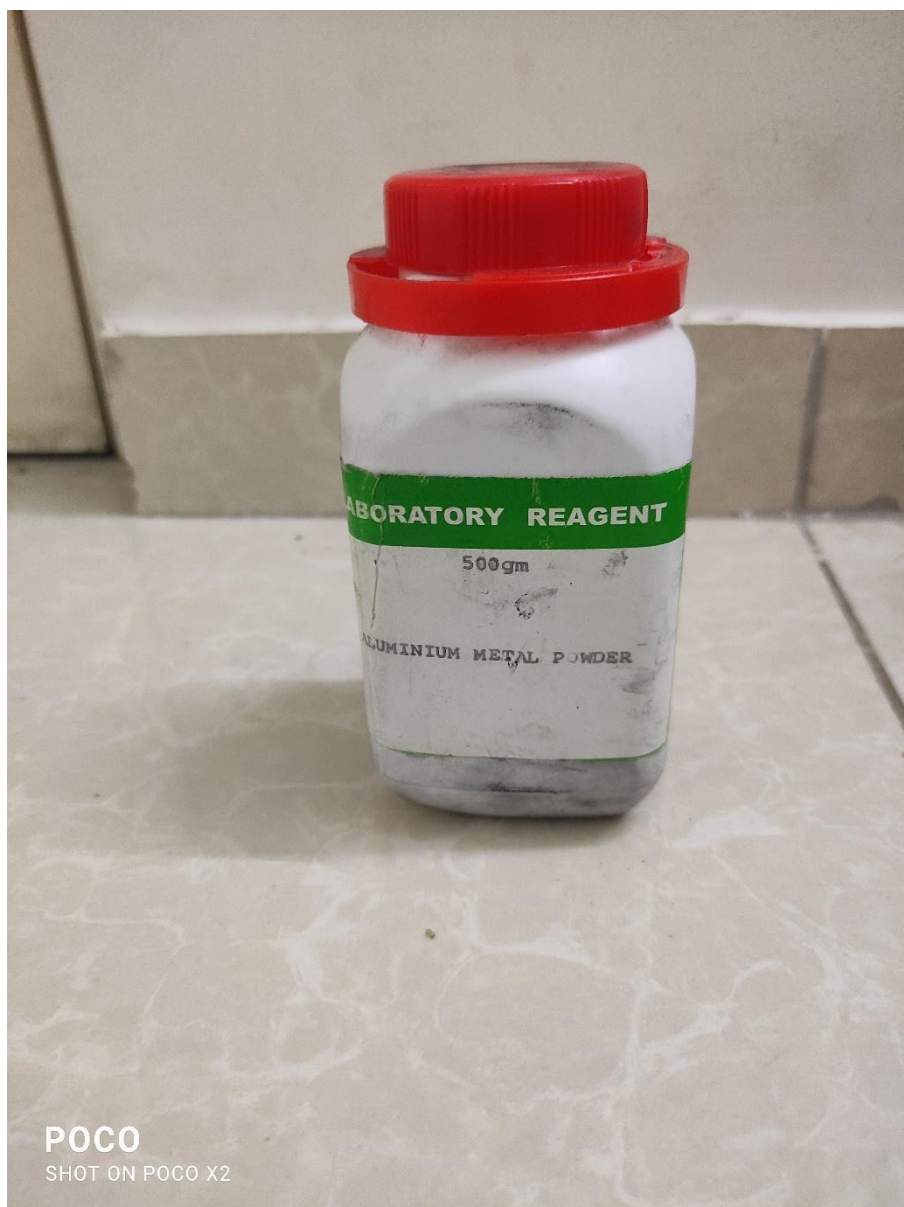


FIG-2

3.2) SILICON CARBIDE

Silicon Carbide is the solitary substance compound of carbon and silicon. It was initially created by a high temperature electro-chemical reaction of sand and carbon. Silicon carbide is a fantastic abrasive and has been created and made into pounding haggles grating items for more than 100 years. Today the material has been formed into a top notch specialized evaluation ceramic with generally excellent mechanical properties. It is utilized in abrasives, refractories, ceramics, and various elite applications. The material can likewise be made an electrical conveyor and has applications in resistance heating, fire igniters and electronic parts. Underlying and wear applications are continually creating.

3.2.1) PROPERTIES OF SILICON CARBIDE

- Low density
- High strength
- Low thermal expansion
- High thermal conductivity
- High hardness
- High elastic modulus
- Excellent thermal shock resistance
- Superior chemical inertness

Silicon Carbide Properties			
Mechanical	SI/Metric (Imperial)	SI/Metric	(Imperial)
Density	gm/cc (lb/ft ³)	3.1	(193.5)
Porosity	% (%)	0	(0)
Color	—	black	—
Flexural Strength	MPa (lb/in ² x10 ³)	550	(80)
Elastic Modulus	GPa (lb/in ² x10 ⁶)	410	(59.5)
Shear Modulus	GPa (lb/in ² x10 ⁶)	—	—
Bulk Modulus	GPa (lb/in ² x10 ⁶)	—	—
Poisson's Ratio	—	0.14	(0.14)
Compressive Strength	MPa (lb/in ² x10 ³)	3900	(566)
Hardness	Kg/mm ²	2800	—
Fracture Toughness K _{IC}	MPa•m ^{1/2}	4.6	—
Maximum Use Temperature (no load)	°C (°F)	1650	(3000)
Thermal			
Thermal Conductivity	W/m•°K (BTU•in/ft ² •hr•°F)	120	(830)
Coefficient of Thermal Expansion	10 ⁻⁶ /°C (10 ⁻⁶ /°F)	4.0	(2.2)
Specific Heat	J/Kg•°K (Btu/lb•°F)	750	(0.18)
Electrical			
Dielectric Strength	ac-kv/mm (volts/mil)	—	semiconductor
Dielectric Constant	—	—	—
Dissipation Factor	—	—	—
Loss Tangent	—	—	—
Volume Resistivity	ohm•cm	10 ² –10 ⁶	dopant dependent

TABLE-2



FIG-3

3.3) CARBON POWDER

Carbon is interesting in its compound properties since it frames various parts prevalent than the all out expansion of the relative multitude of different components in blend with one another.

The greatest gathering of every one of these segments is the one shaped via carbon and hydrogen. We know at least around 1 million natural parts and this number increments quickly consistently. Albeit the characterization isn't severe, carbon frames another arrangement of mixtures considered as inorganic, in a much lower number than that of the natural mixtures.

Natural carbon exists in two very much characterized allotropic translucent structures: precious stone and graphite. Different structures with little crystallinity are vegetal carbon and dark smoke. Synthetically unadulterated carbon can be set up by termic decay of sugar without air. The physical and synthetic properties of carbon rely upon the translucent design of the component.

Carbon Powder Properties (Theoretical)

Molecular Weight	12.01
Appearance	Black powder
Melting Point	3652 - 3697 °C (sublimes)
Boiling Point	4200 °C
Density	2.267 g/cm ³
Solubility in H₂O	N/A
Electrical Resistivity	N/A
Electronegativity	2.55 Paulings
Heat of Vaporization	128 K-Cal/gm atom at 4612 °C
Specific Heat	N/A
Tensile Strength	N/A
Thermal Conductivity	119-165 W/m/K

TABLE-3



FIG-4



FIG-5

CHAPTER 4

4.1) ALUMINIUM METAL MATRIX COMPOSITE

Presently a days, aluminium metal framework composites are utilized in Designing applications like auto industry, airplane, guard what's more, aviation segments. Aluminium framework composites have improved properties like great strength, improved stiffness, brought down thickness, high thermal properties, controlled thermal expansion and improved wear resistance which can't be gotten by utilizing the current ordinary material. In Aluminium MMC, Aluminium/Aluminium Alloys like Al–Si, Al–Cu, Al–Si–Mg is the principle constituent. For the interaction of AMMC, support like SiC Al₂O₃, C, B, B₄C, AlN, SiO₂ and BN are utilized to implanted with the Aluminium/Aluminium Alloy. Aluminium MMC is skilled with the best upgraded properties, like higher strength, high specific modulus, great wear resistance and lower thermal expansion. At the point when SiC support is utilized in AMMC, it results in higher rigidity, better hardness, thickness and wear obstruction of the Al Alloy.

CHAPTER 5

5.1) MANUFACTURING PROCESS OF ALUMINIUM METAL MATRIX

In Manufacturing Process, the transformation of one structure to the required type of the item with its appropriate measurements takes place. As per that, different cycles are completed for the manufacture of AMMC..

5.1.1) SOLID STATE STRATEGIES

In solid State fabricating process, by applying appropriate temperature and pressing factor, the metal and reinforcement get bonded also, changed over into an exceptional metal

5.1.2) POWDER METALLURGY METHOD

In this strategy, the metal powder and the reinforcement alloys are taken in the chose proportion, blended by hand/or machine. At that point it gets poured and manufactured through the conservative passes on in regular machines to get the required shape and size. This manufacturing cycle might be conveyed out by cold or hot squeezing. Later the green compacts are treated in shut chamber for sintering interaction and make the compacts into legitimate thickness items. In this technique, there is an opportunities for decrease of metal removal or shape transformation. In the examination furthermore, advancement of AMMC, when Al_2O_3 is utilized as support with the

Aluminium Powder, the resultant compacts have the greater porosity. However, it tends to be utilized just when creation is made in a bigger scope.

5.1.3) DIFFUSION BONDING METHOD

It this strategy, the method received is to join the comparative or different metal layers and filaments into sandwich metal under the necessary tension. The dispersion interaction can be constrained by temperature, pressure and the dissemination timing. Temperature can be differed up to 70% of framework softening point. Pressing factor can be applied till it is sufficient to diffuse the surface. The fundamental benefit of this dissemination strategy lies in its capacity to control the fibre direction with metal volume division with different metal grid composites.

5.2) LIQUID STATE METHODS

The support is blended well in with the liquid metal framework with the assistance of outer mechanical gadget before the liquid metal gets into hardening. The drawbacks of this interaction are that the greater expense because of the outer guide with moderate porosity and weltability. In any case, we can improve holding in metal framework with reinforcement materials.

5.2.1) STIR CASTING METHOD

Assembling interaction of AMMC and its composite in stir casting method is broadly applied for bigger creation with a negligible expense and adaptable creation method. The appropriate support is included liquid metal at the liquefying temperature. At that point with the assistance of outside gadget, blending measure is completed to disseminate the support altogether all through the liquid metal to maintain a strategic distance from the heterogeneous dispersion and to decrease the porosity. Aluminium powder, as a metal and the support Alumina is utilized in this technique and it is seen that fired alumina is mostly not Conveyed.



POCO
SHOT ON POCO X2



FIG-7

5.2.2) SQUEEZE INFILTRATION METHOD

This is another technique to make AMMC in fluid state. Squeeze infiltration strategy, By utilizing the closed die, metal gets hardening under tension. Because of the development of shape parts, pressure is applied over the liquid metal and it infiltrates over the scattered stage. Crush Method producing parts have the highlights of high weldability, high temperature resistance, great surface finish, high corrosion resistance and high dimensional precision.

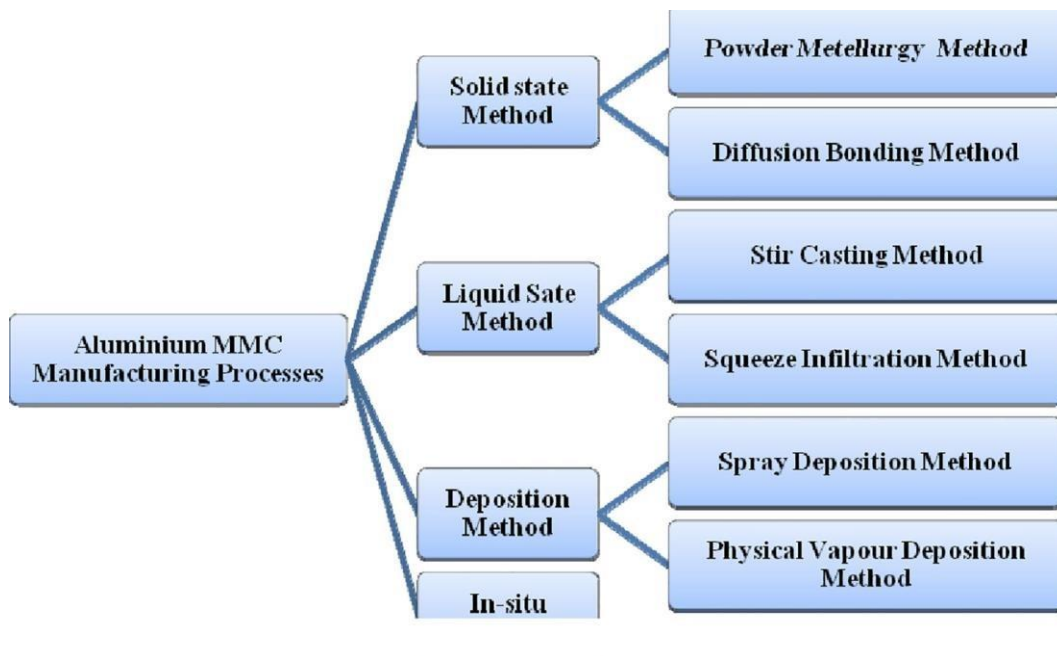
5.3) DEPOSITION METHOD

Beads of liquid metal are splashed with support stage preposterous and the metal is permitted to get hardening. The significant benefit of this interaction is the eventual outcomes have great grain size with accomplished microstructure. However, the fundamental inconvenience is that the reinforcement isn't consistent, straightforward shapes what's more, significant expense.

5.3.1) SPRAY DEPOSITION METHOD

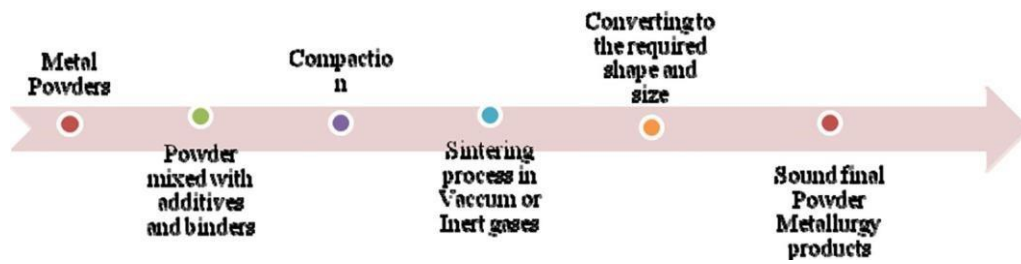
This strategy is additionally called as Osprey Process. With the assistance of high velocity dormant gas fly, atomized fine liquid metal beads are splashed ludicrous metallic substrate with the expansion of support The metal is then permitted to be set. To get the high thickness store MMC or wanted MMC, the different boundaries like testimony

rate, distance between splash spout to substrate, dormant gas utilized, splashing pressing factor and point of shower are to be thought of. The expense of this strategy is less.



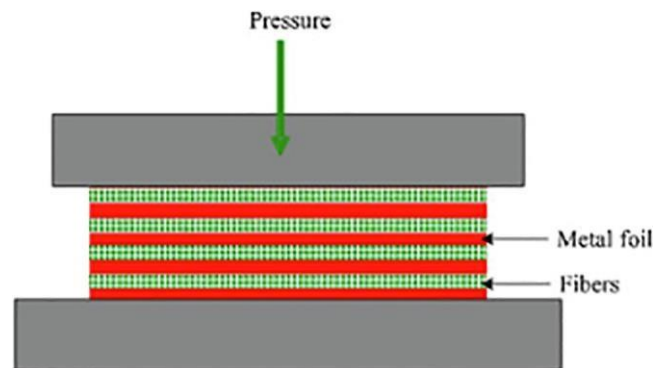
AMMC Manufacturing process chart

FIG-8

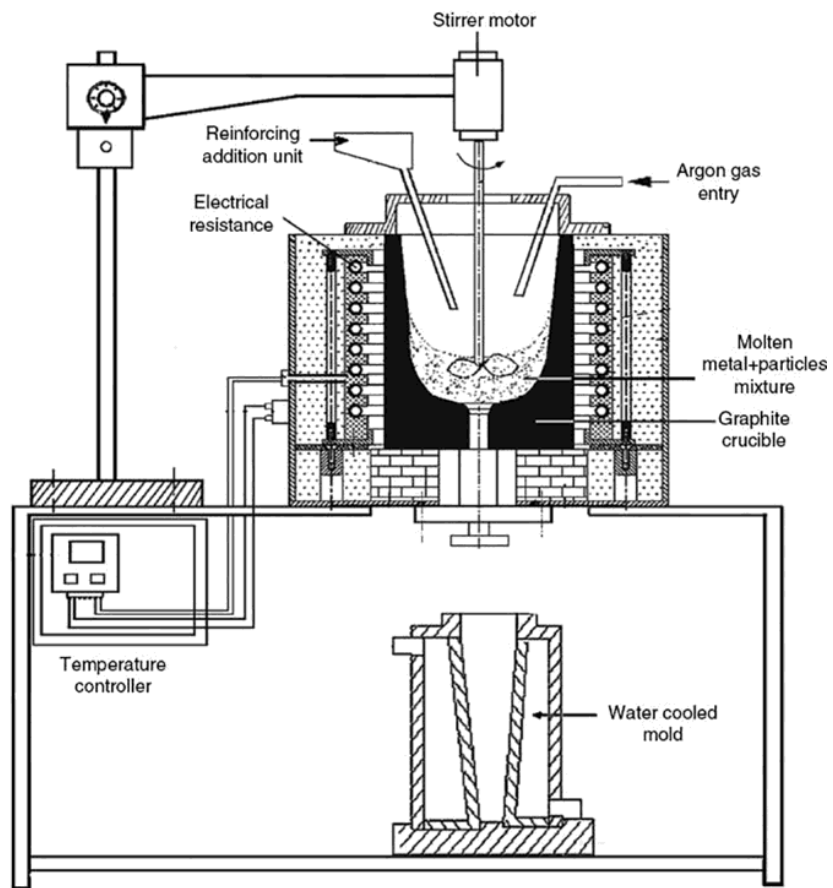


Powder metallurgy process flow chart

FIG-9



Diffusion bonding method



Stir casting

CHAPTER 6

PROCESS:

6.1) POWDER METALLURGY PROCESS:

The principle destinations of this exploration is to create Al-SiC-C composite utilizing powder metallurgy technique in the rate proportion of 91:5:4 and 93:5:2, furthermore, to dissect the hardness, thickness, Microstructure, XRD test, FTIR test also, SEM investigation of Al-SiC-C composite material.

MATERIAL DETAILS:

Aluminium metal powder of molecule size under 120 cross section (74 μm) and SiC powder of molecule size 320 cross section (36 μm) were utilized in this exploration. Standard example of Al-SiC-C Composite with different extents of SiC and C (2 and 5%) were compacted and sintered.

6.2) PRE-TREATMENT OF REINFORCEMENT PARTICLES :

The support molecule (SiC) and (C) is warmed to a temperature of 570 C in mute heater and the equivalent is kept up as holding temperature for one hour prior to utilizing it as support for the creation of Metal Matrix Composite tests.

The serious issues experienced in the manufacture of carbon/aluminium composites are:

- a) Reaction among aluminium and carbon.
- b) Poor wetting of carbon by liquid aluminium. .

c) Oxidation of the carbon powders.

6.3) POWDER METALLURGY METHOD:

The Al-SiC-C examples were set up by utilizing powder metallurgy technique. The accompanying advances were received in this research for test planning

1. Blending/Mixing
2. Compaction
3. Sintering

6.4) MIXING OF POWDERS:

The necessary measure of metal powders was weighed suitably. The gauged powders were isolated into clumps according to the arrangement of the examples . Mixing also, blending of powders is completed in planetary ball plant with the ball to powder proportion 10: 2: 1. It is indispensable to mix and blend the powders to achieve homogenous combination during conservative

6.5) COMPACTION:

The blended powders were compacted by utilizing water driven press. A pass on comprised of hardened steel with the distance across of around 10 mm were utilized. Every example was hard squeezed utilizing pressure 100 kg/cm² for a period of 20 min, 30 min and 40 min to get the green compacts. Tube shaped compacts of around

10mm distance across 0.8 mm thickness were compacted utilizing the physically worked water driven press.



FIG-12



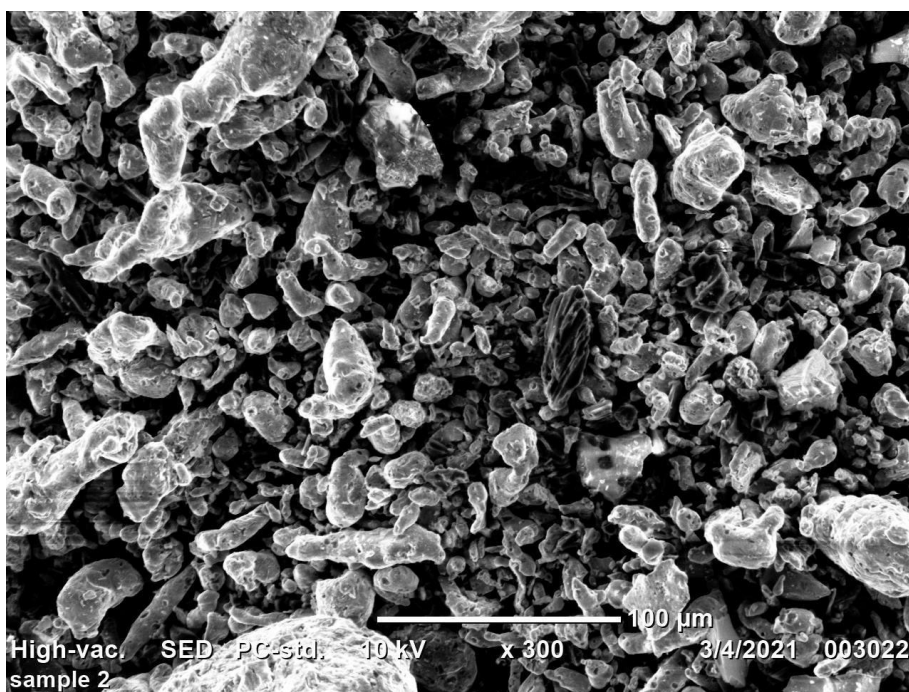
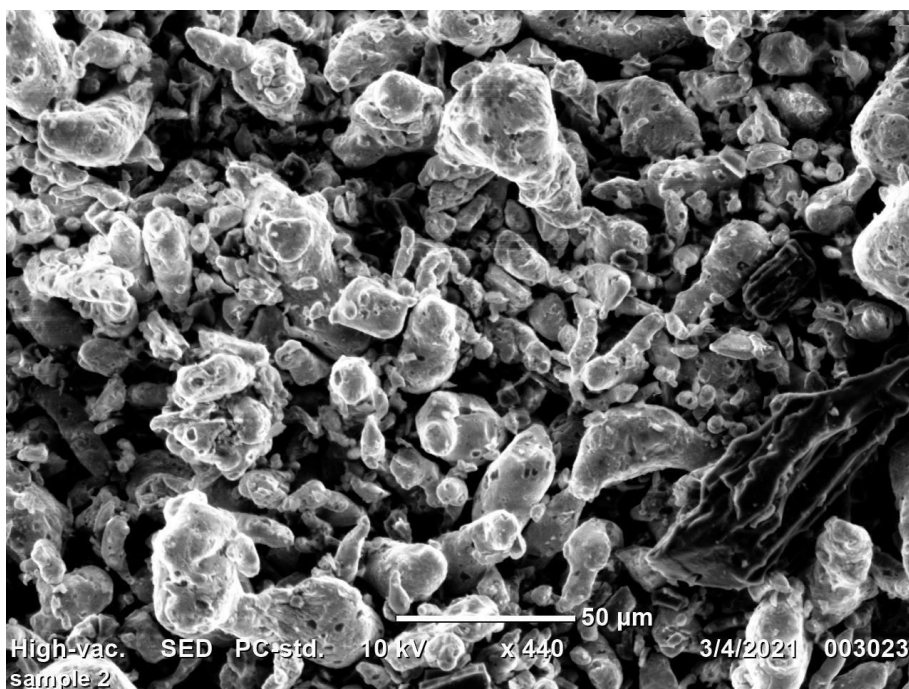
CHAPTER 7

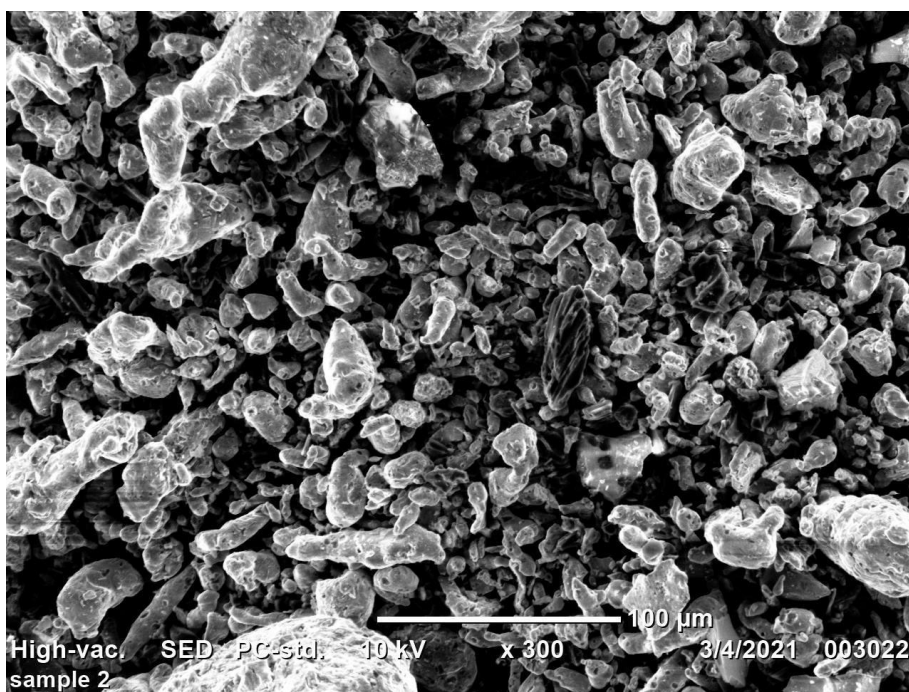
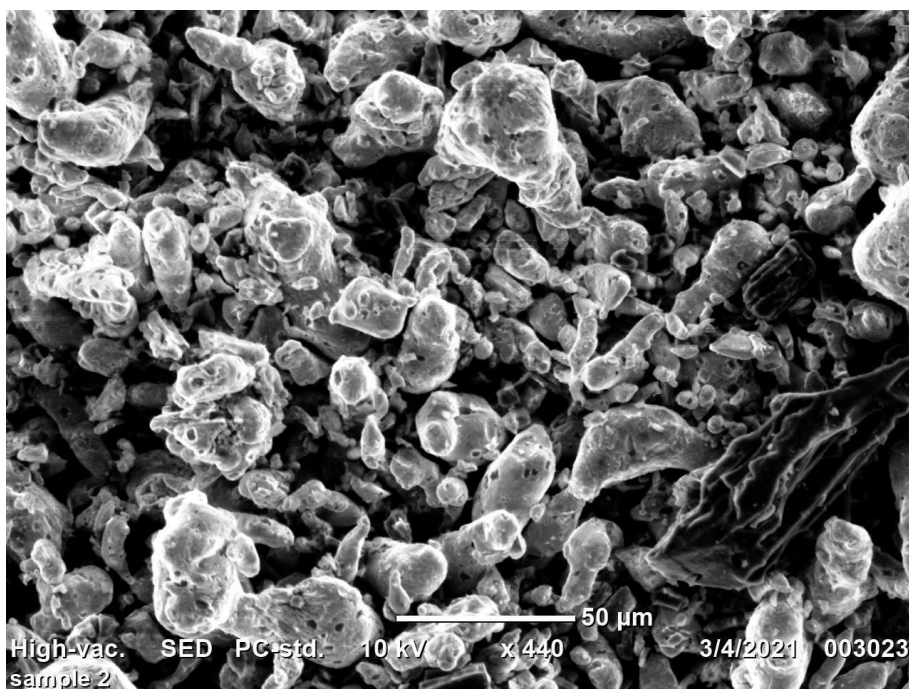
RESULTS AND DISCUSSION:

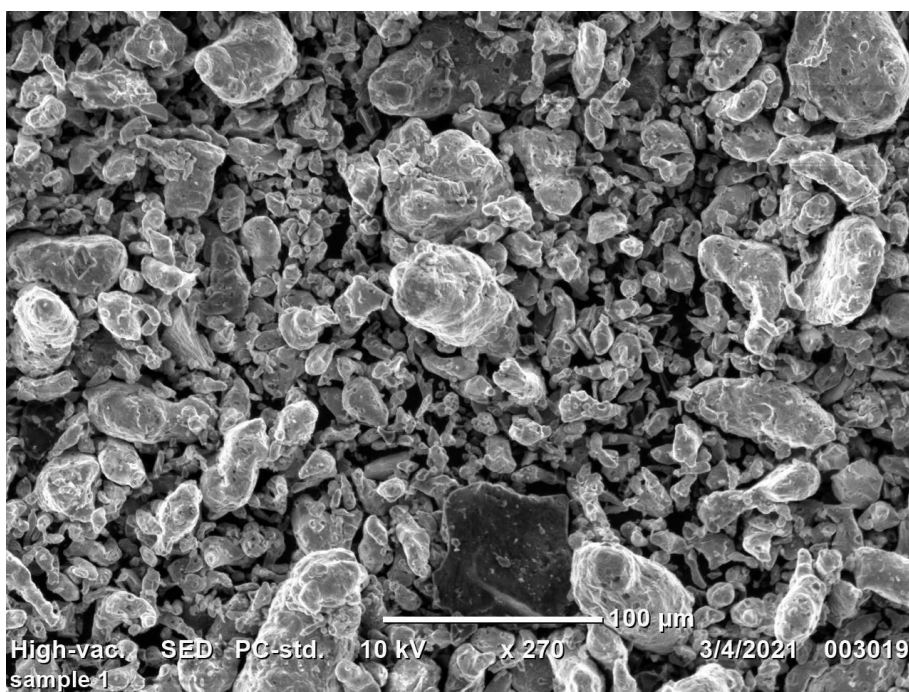
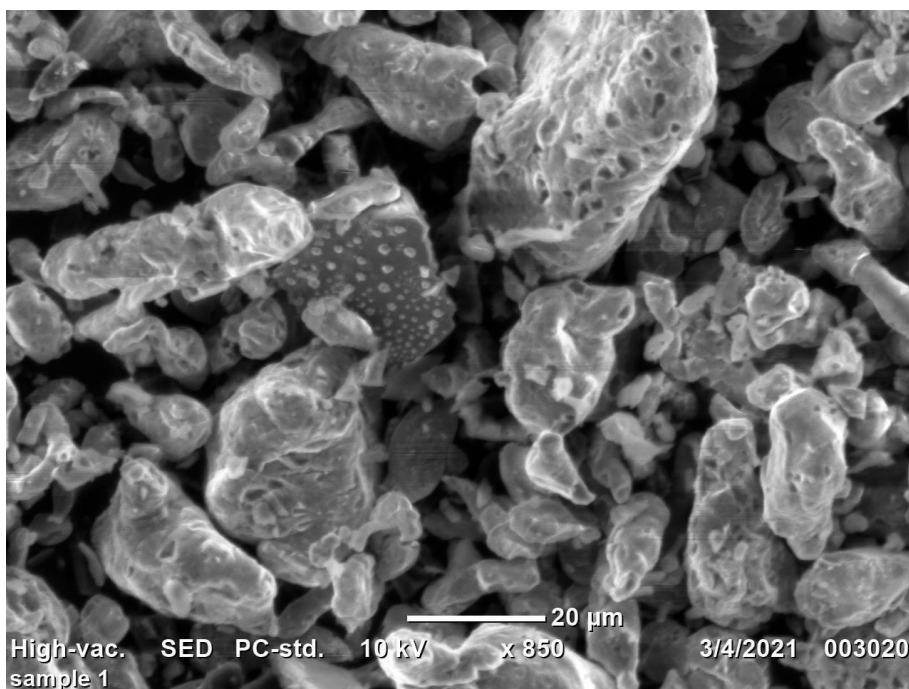
7.1) SEM ANALYSIS:

Scanning electron microscopy (SEM) is an incredible scientific and insightful strategy to assess a wide scope of materials for surface cracks, defects, consumption or foreign substances with the assistance of high-goal amplifications. Energy dispersive x-beam spectroscopy (EDX) examination is utilized to secure extra comprehension of the materials during SEM investigation measure. At the point when SEM examination is joined with EDX investigation, a complete metallurgical assessment is achieved.

SEM examination filters an example utilizing an engaged light emission during which time the electrons produce different signs to make high amplification pictures of the example's surface geology. Utilizing EDX examination, metallurgical specialists can consider the example in detail and give basic recognizable proof and quantitative compositional data of the example. SEM and EDX investigation has an assortment of uses and permits customers to comprehend the wear properties of a material







7.2) X-RAY DIFFRACTION:

X-Ray diffractometers comprise of three fundamental components: a X-ray tube, an example holder, and a X-ray identifier. X-Ray Diffraction Instrument Bruker's X-Ray Diffraction D8-Discover instrument. Subtle X-rays are created in a cathode beam tube by warming a filament to deliver electrons, speeding up the electrons toward an objective by applying a voltage, and besieging the objective material with electrons. At the point when electrons have adequate energy to remove internal shell electrons of the objective material, trademark X-ray spectra are delivered. These spectra comprise of a few parts, the most well-known being $K\alpha$ and $K\beta$. $K\alpha$ comprises, to some extent, of $K\alpha_1$ and $K\alpha_2$. $K\alpha_1$ has a somewhat more limited frequency and twice the force as $K\alpha_2$. The particular frequencies are normal for the objective material (Cu, Fe, Mo, Cr). Sifting, by foils or precious stone monochromators, is needed to deliver monochromatic X-rays required for diffraction. $K\alpha_1$ and $K\alpha_2$ are adequately close in frequency with the end goal that a weighted normal of the two is utilized. Copper is the most well-known objective material for single-precious stone diffraction, with $\text{Cu}K\alpha$ radiation = $1.5418\text{\AA}$. These X-rays are collimated and coordinated onto the example. As the example and identifier are pivoted, the force of the reflected X-rays is recorded. At the point when the math of the episode X-rays impinging the example fulfills the Bragg Equation, useful obstruction happens and a top in power happens. A finder records and cycles this X-ray sign and converts the sign to a check rate which is then yield to a gadget, for example, a printer or PC screen.

Analysis Results

General Information

Anal

ysis

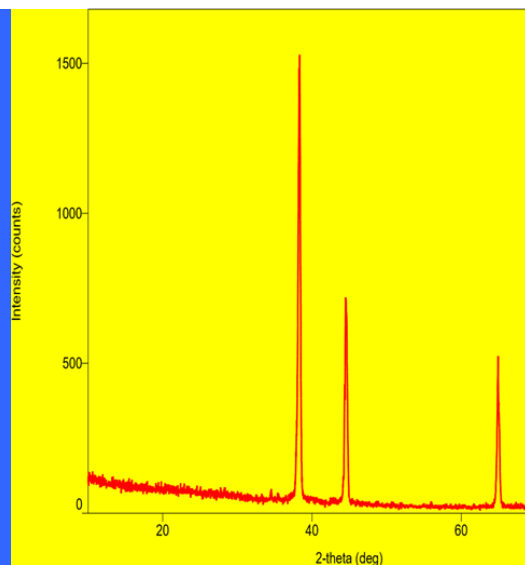
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		ent date	16
			11:42:00

File name sample 1_Theta_2-Theta.asc Operator

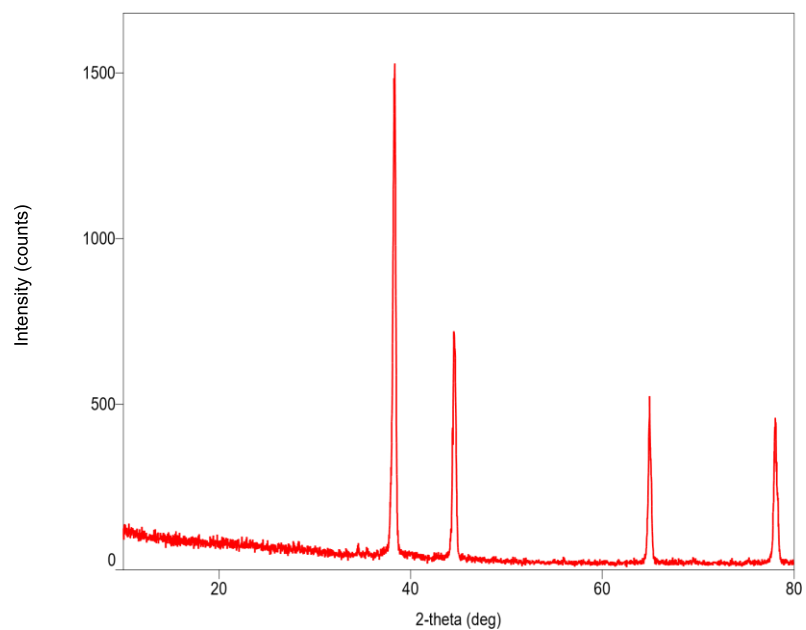
Comment

Measurement profile



Measurement conditions

X-Ray	30 kV , 12 mA	Scan speed / Duration time	8.0000 deg./min.
Goniometer		Step width	0.0200 deg.
Attachment	-	Scan axis	2Theta/Theta
Filter	None	Scan range	10.0000 - 80.0000 deg.
CBO selection slit	-	Incident slit	-
Diffrected beam mono.	None	Length limiting slit	-
Detector	SC-70	Receiving slit #1	-
Scan mode	CONTINUOUS	Receiving slit #2	-



Peak list

Peak list							
No.	2-theta(deg)	d(ang.)	Height(counts)	FWHM(deg)	Int. I(counts deg)	Int. W(deg)	Asym. factor
1	38.337(6)	2.3460(4)	1021(32)	0.329(4)	400(3)	0.392(16)	2.4(2)
2	44.546(8)	2.0323(3)	493(22)	0.340(5)	194(2)	0.39(2)	1.21(10)
3	64.924(9)	1.43514(18)	356(19)	0.279(8)	119.7(17)	0.34(2)	1.47(18)
4	78.063(7)	1.22318(9)	367(19)	0.290(7)	128.1(17)	0.35(2)	1.81(18)

Parameters used for WPPF

Profile parameters

Common parameter	Background	Data	sample 1_Theta_2-Theta
		Function name	B-spline
		param0	719.77229042239105
		param1	559.51060622437217
		param2	319.03139579285937
		param3	188.0099625393263
		param4	108.24611144248858
		param5	152.2148024734536
		param6	104.73265947313121
		param7	137.11075533954624
		node0	10
		node1	33.32
		node2	48.88000000000003
		node3	59.24000000000002
		node4	69.59999999999994
		node5	80
Common parameter	Peak shift		
		Function name	Shift axial displacement
		param0	0
		param1	0
		param2	0

SAMPLE 2:

Analysis Results

General Information

Anal

ysis

date 2021/03/16 14:18:05

Sample name sample 2

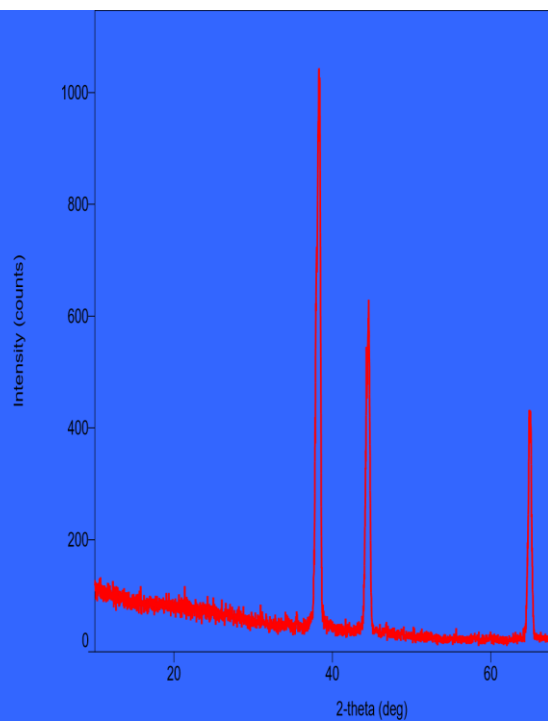
Measurem 2021/03/
ent date 16
11:51:00

File name sample 2_Theta_2-Theta.asc

Operator

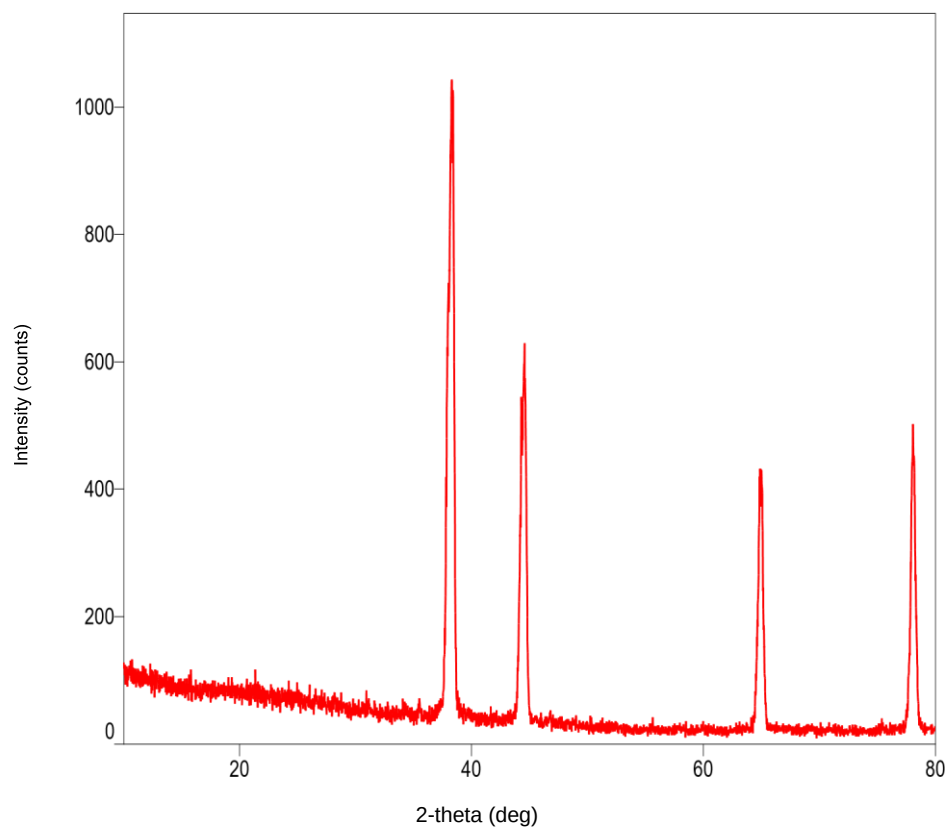
Comment

Measurement profile



Measurement conditions

X-Ray	30 kV , 12 mA	Scan speed / Duration time	8.0000 deg./min.
Goniometer		Step width	0.0200 deg.
Attachment	-	Scan axis	2Theta/Theta
Filter	None	Scan range	10.0000 - 80.0000 deg.
CBO selection slit	-	Incident slit	-
Diffrected beam mono.	None	Length limiting slit	-
Detector	SC-70	Receiving slit #1	-
Scan mode	CONTINUOUS	Receiving slit #2	-



Peak list

No.	2-theta(deg)	d(ang.)	Height(counts)	FWHM(deg)	Int. I(counts deg)	Int. W(deg)	Asym. factor
1	37.936(17)	2.3699(10)	362(19)	0.273(17)	119(19)	0.33(7)	1.3(5)
2	38.228(16)	2.3524(10)	605(25)	0.27(5)	194(45)	0.32(9)	1.3(5)
3	38.432(14)	2.3404(8)	521(23)	0.18(2)	113(30)	0.22(7)	1.3(5)
4	44.326(17)	2.0419(8)	313(18)	0.45(3)	160(15)	0.51(8)	0.83(8)
5	44.598(10)	2.0301(4)	253(16)	0.24(3)	68(16)	0.27(8)	0.83(8)
6	64.931(11)	1.4350(2)	307(18)	0.424(8)	149.3(18)	0.49(3)	1.52(15)
7	78.085(10)	1.22289(13)	356(19)	0.385(7)	151.1(19)	0.42(3)	1.73(16)

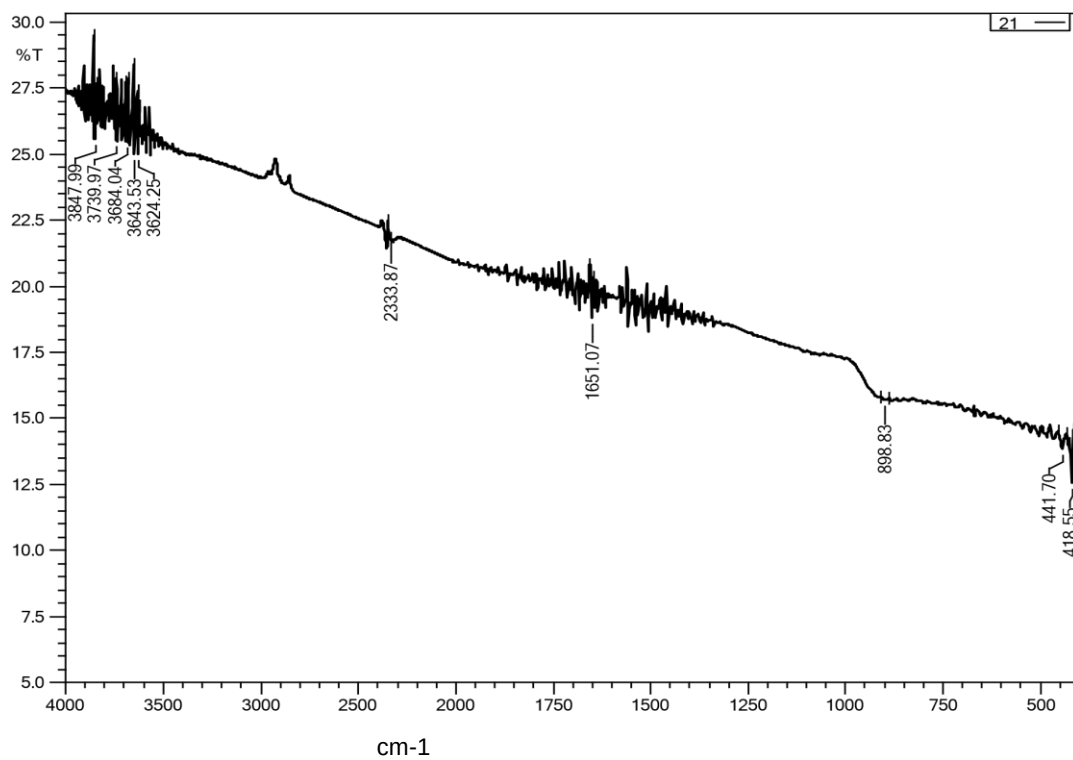
FOURIER TRANSFORM INFRARED SPECTROSCOPY

FTIR is generally helpful for distinguishing synthetic compounds that are either natural or inorganic. It very well may be used to quantitate a few segments of an obscure combination and for the investigation of solids, fluids, and gases. The term Fourier Transform Infrared Spectroscopy (FTIR) alludes to an advancement in the way wherein the information is gathered and changed over from an impedance example to a range. It is an incredible asset for recognizing kinds of synthetic bonds in a particle by delivering an infrared retention range that resembles a sub-atomic "unique finger impression". The frequency of light consumed is normal for the substance bond as can be found in this explained range. The FT-IR (Bruker-Tensor) was set up in the Core Lab in 2008 with the DRDO award of the Institute.

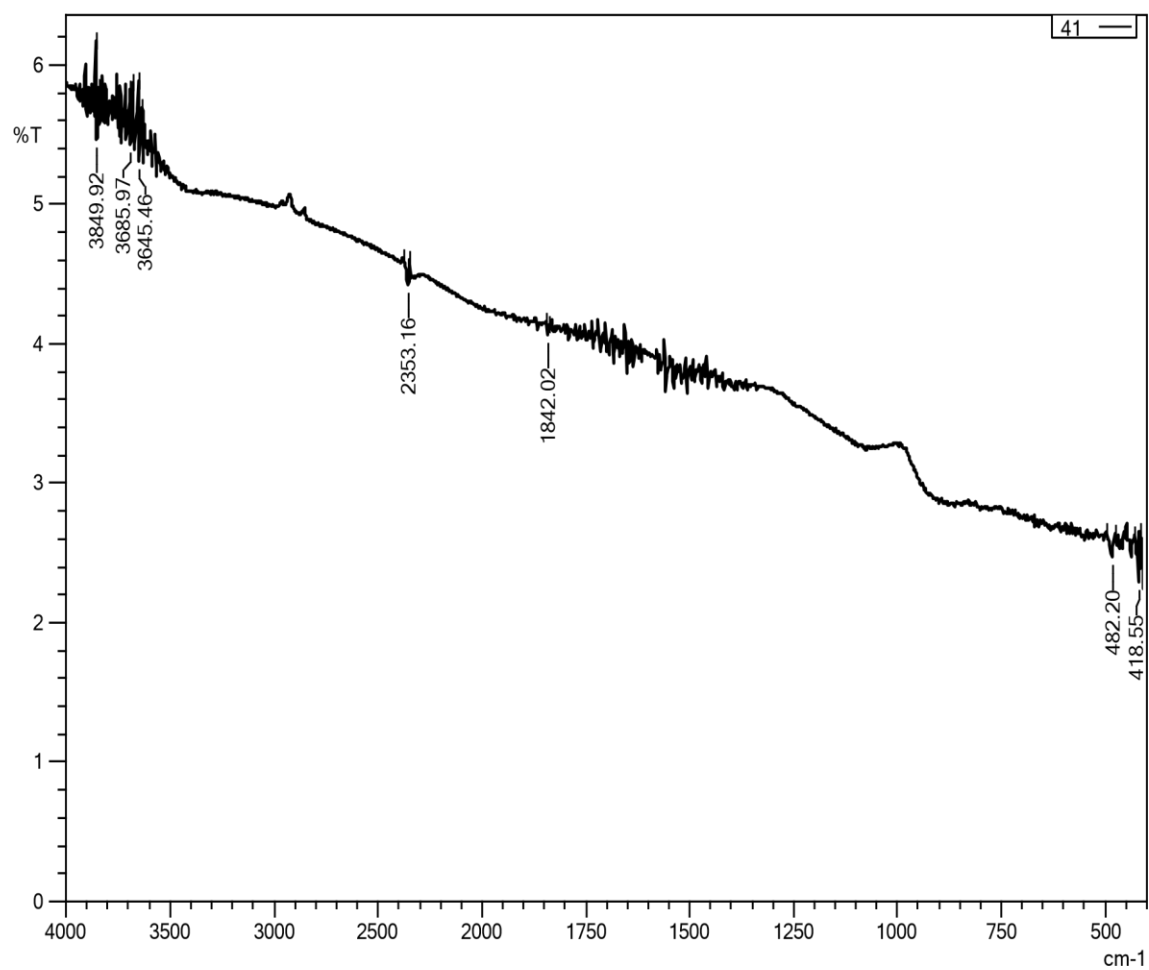
PRINCIPLE:

Molecular bonds vibrate at different frequencies relying upon the components and the sort of bond. For some random bond, there are a few explicit frequencies at which it can vibrate. As indicated by quantum mechanics, these frequencies relate to the ground state (least recurrence) and a few energized states (higher frequencies). One approach to make the recurrence of an atomic vibration increment is to energize the bond by having it retain light energy. For some random change between two expresses the light energy (controlled by the frequency) should precisely rise to the distinction in the energy between the ground state and the initially energized state.

SAMPLE-1:



SAMPLE-2:



CONCLUSIONS

The Al–Si composites are utilized fundamentally to make the different auto parts like Piston, chamber blocks, Piston rings, associating pole, slowing down plate, and so on. Be that as it may, low strength, hardness, and wear opposition are limited to their utilization in a few applications. The silicon carbide-based aluminium matrix composites showed preferable properties over base metal composites. Then again, the carbon, as an alloying component, improves the properties of the steel essentially. In the present exploratory examination, the carbon and silicon carbide particulates are used as the support stage to manufacture Al–Si amalgam based metal lattice composites. The powder metallurgy strategy was used to form the novel composites as it is basic, less expensive, and generally adaptable, among different cycles. The composites were created by shifted weight part of carbon (0–4% with the means of 1.5%), while the synthesis of silicon carbide (10%) was kept steady. The attributes investigation of the aluminium grid composites was performed utilizing standard testing strategies like SEM, XRD, FTIR, and so on. From the acquired outcomes, the accompanying ends can be drawn.

SEM and FTIR result guarantees the event and scattering of the silicon carbide and carbon particulates inside the lattice grain structure, absent a lot of groups arrangement anyplace. The density of mono and crossover particulates reinforced composites increments with increasing the high-

density reinforcement content. The mechanical and tribological conduct of SiC+C supported mixture composites showed improved results when contrasted and single SiC supported composite or then again unreinforced amalgam. The incorporation of 10 wt.% of SiC shows an improvement of 12.44% in hardness, 8.62% in strength, 33.07% in wear resistance, with a little decrease in friction coefficient and flexibility (prolongation)

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