CHARACTERIZATION STUDY OF AL 7075 REINFORCEMENT WITH GRAPHENE

ABISHEK.P[1], ALOSHIYES JOB WILSON.M[2], ARAVIND.A[3], DHARANI DHARAN.M[4], P.RAMU (A.P)[5]

[1]Abishek.P , Department of Mechanical, SRM Valliammai Engineering College, Tamilnadu, India

[2]Aloshiyes job Wilson.M, Department of Mechanical, SRM Valliammai Engineering College, Tamilnadu, India

[3] Aravind. A, Department of Mechanical, SRM Valliammai Engineering College, Tamilnadu, India

[4]Dharani dharan.M Department of Mechanical, SRM Valliammai Engineering College, Tamilnadu, India

[5]P.Ramu.,M.E.,(Ph.D.) *Assistant professor, Department of Mechanical, SRM Valliammai Engineering College, Tamilnadu, India*

ABSTRACT

At present, aluminum metal matrix composites have been widely used in engineering fields due to their improved hig h specific strength, wear resistance, low density, high strength and good structural rigidity, especially in automobile s, aerospace, ships and process industry and other fields. Currently, hybrid composites play an important role in en gineering applications. In the present work, aluminum alloy 7075 was used as the matrix and graphene as the filler material. Hybrid composites are produced by the liquid metallurgy (agitated casting) route.This method is relatively inexpensive and effective.The objective of this work is to predict the tensile strength, stiffness and impact behavior o f composite materials. Microstructural studies were carried out using a metallographic microscope to obtain the dis tribution of graphene in the aluminum matrix.

Keyword: - *Composite material, Aluminium metal matrix, Aluminium 7075, Graphene*

1. INTRODUCTION

The engineering world is always looking for the miracle material for all types of service conditions. This stems from the need to make progressive discoveries affordable to scientists. This affordability quotient has convinced many res earchers to develop materials capable of meeting various unexplored conditions. In today's world, all general-purpose materials have exhausted their various uses and reached their limits. But the endless quest for civilization e nquires materials suitable for harsher environments.

This inescapable situation necessitates the creation of new materials from various combinations of other compatible materials. It has been with human beings since ancient times. In all corners of the world, materials are combined to achieve certain desired properties, although each case is different from the others, i.e., one can create new material with unique properties that can be customized and differ from their basic ingredients.

This concept applies to a class of materials called composites, in which different types of materials must be combine d with reinforcements, which help improve performance. Neither matrix nor reinforcement alone will suffice, but co mposites can. This change of ownership can be controlled in several ways, viz. Check the quality of the reinforceme nt of the matrix. Previous researchers have reported that during dry sliding, the metal/graphite composite forms a c ontinuous layer of solid lubricant on the surface.This phenomenon occurs due to the fracture of graphite particles b elow the sliding surface of the composite, which helps to reduce the magnitude of shear stress, alleviate plastic defor mation in the underground region, inhibit contact metal on metal and working. Acts as a solid lubricant between tw o sliding surfaces, thereby reducing friction, wear and improving the resistance to seizing of composite materials.

2. OBJECTIVES

The objective of this work is to predict the tensile strength, stiffness and impact behavior of composite materials. Mi crostructural studies were carried out using a metallographic microscope to obtain the distribution of graphene in t he aluminum matrix. Composite materials are the combination of two materials with different physical and chemical properties. When combined, they create a specialized material to do a specific job, like being stronger, lighter, or el ectrically resistant. They also increase strength and stiffness.
However, as a class of materials, composites tend to have the following properties: high strength; high modulus; lo w density; excellent resistance to fatigue, creep, creep rupture, corrosion and wear; and low coefficient of thermal e xpansion.

3.MATERIAL CHOSEN

ALUMINIUM 7075:

Aluminum alloy 7075 (AA7075) is an aluminum alloy with zinc as the main alloying element. It has excellent mecha nical properties and exhibits good ductility, high strength, toughness and good fatigue resistance. Aluminum 7075 has a reputation as the strongest grade of aluminum alloy among many widely used in various industrial appli cations. It offers strength similar to many steel alloys, while offering the advantages of ease of machining, corrosion resistance and light metal.
It is important to purchase this alloy from an aluminum supplier with extensive experience and the ability to serve y our industry broadly.
At Howard Precision Metals, we work closely with a variety of leading producers in the metal and aluminum supply industry to ensure that you receive the top quality product your application requires. Our sawing services allow us t o implement modern technical processes that allow us to consistently deliver the ideal aluminum profiles our custom ers need. As a member of the 7075 series, it is one of the strongest alloys available, rivaling many types of steel. Alth ough it has high strength, it has lower corrosion resistance than other common aluminum alloys and does not offer t he same level of machinability or weldability.

PROPERTIES OF ALUMINIUM-7075:

S.NO	***PROPERTY***	***VALUE***
1.	*Density*	*2.81*
2.	*Hardness, Vickers*	*175HV*
3.	*Ultimate tensile strength*	*572Mpa*
4.	*Tensile yield strength*	*503 Mpa*
5.	*Modulus of elasticity*	*71.7Gpa*
6.	*Thermal conductivity*	*130 W/m-k*
7.	*Melting point*	*477-700 ° C*

REINFORCEMENT POWDER GRAPHENE:

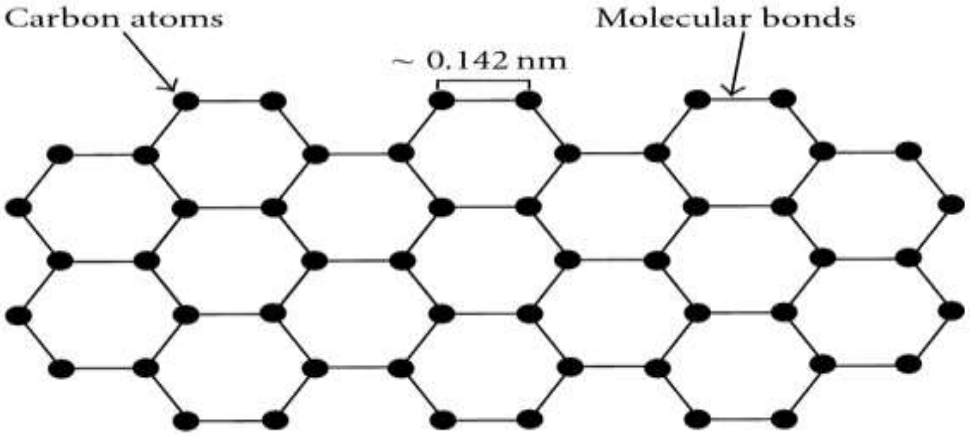
Graphene, a twodimensional carbon crystal, has emerged as a promising material for detecting and modulating ne uronal activity in vitro and in vivo. In this review, we provide a foundation on how manufacturing processes that p roduce graphene and graphene oxide produce material properties that can be tailored to various applications. We further discuss how graphene can be assembled with other biocompatible materials of interest to fabricate novel h ybrid composites with desirable properties for biological interfaces. We then highlight the growing utility and uniq ue properties of graphene that could be multiplied in the future for cross
modal modulation or interrogation of neural networks. As the biological effects of graphene remain an active area of research, we discuss recent developments, with a particular focus on how the surface coating and surface prope rties of graphene relate to its biological effects.
We discuss studies performed in nonmouse and mouse systems, highlighting the preclinical aspects of graphene's p otential without compromising its tangible clinical implementation. Graphene is a layer of carbon atoms arranged in a hexagonal lattice. It's the building block of graphite (used, among other things, in pencil nibs), but graphene is a remarkable substance in its own right -
with many amazing properties that have earned it the title of a miracle material. What makes graphene so special is its sp2 hybridization and its very thin atomic thickness (0.345 nanometers).
These properties allow graphene to beat many records in terms of resistance, electrical conductivity and thermal c onductivity.
Graphene powder can be used as filler material in composite materials to improve their mechanical and electrical properties. It can also be used as an additive in lubricants and coatings to improve their wear resistance and electr

ical conductivity. Additionally, graphene powder can be used in energy storage applications, such as lithium-ion batteries, to increase their energy density and charging speed.

PROPERTIES OF GRAPHENE:

S.NO	***PROPERTY***	***VALUE***
1.	*Charge carrier mobility*	*~200 000 cm^2/V-s*
2.	*Thermal conductivity*	*~5000 W/m-K*
3.	*transparency*	*~97.4%*
4.	*Specific surface area*	*~2630 m^2/g*
5.	*Young's modulus*	*~1 Tpa*
6.	*Tensile strength*	*~1100Gpa*
7.	*Band gap*	*Zero*

STRUCTURE OF GRAPHENE:



4. EXPERIMENTAL PROCEDURE

STIR CASTING PROCESS:

The process mentioned above is the most important process in liquid metallurgy technology which is more studied to day. It involves incorporating reinforcement particles into a liquid aluminum cast and letting the mixture solidify.

VARIOUS PROCESS:

- *Stirring of molten metals by mechanical stirrer*
- *Feeding of reinforcement material*
- *Continuous stirring of mixture (matrix + reinforcement)*
- *Pouring of mixture in the mold*
- *Cooling and solidification*

Stirring of molten metals by mechanical stirrer:

Agitation casting is an appropriate processing technique for the production of aluminum matrix composites and alu minum matrix hybrid composites because it is an economical process and more suitable for largescale production. T he first step in stir casting is to melt the aluminum. During melting, the molten aluminum reacts with the atmosphere and humidity to form a layer of aluminum (7075) and the metal becomes liquid.

Feeding of reinforcement:

Once the metal has become liquid through the melting process of stirring casting. The next step is to add enhanced g raphene. And graphene is a nanomaterial, so it is easy to diffuse in the air, so the graphene is covered and wrapped by aluminum foil.

Continuous stirring of mixture (matrix + reinforcement):

When the temperature reaches to the melting point the lid of the furnace is been opened and the stirrer is inserted and then the reinforcement and the metel will get nicely mixed by this process.

Pouring of mixture in the mold:

After completing the melting process in the furnace, the composite material is get poured into a mold to get shaped. And the liquid melt material will get changed into composite material by the atmospheric temperature.

Cooling and solidification:

The final process of the stir casting is the cooling and solidification. In this stage the pored molten metal gets a rigid body. Due to the atmospheric pressure the liquid stage metal is changed into the solid state. And the totoal amount of the composite material properties are get changed due to the addition of the reinforcement. And the metal gets stronger. And finally by use the mold we can obtain the plate shaped composite material. After the composite material removed from the molt it will be hot. And the metal should be cooled with atmospheric temperature no sudden cooling could occur due to the property change in the metal.

MATERIAL TESTING PROCESS:

- *Tensile test*
- *Compression test*

- *Impact test*

Tensile test:

The component of aluminium 7075 reinforcement with graphehe. In this material tensile test is comducted. So with the help of this test we can able to measure the yield stress and elongation. For undergoing tensile test the material should be measured and undergo with EDM cutting process with according to ASD standard.

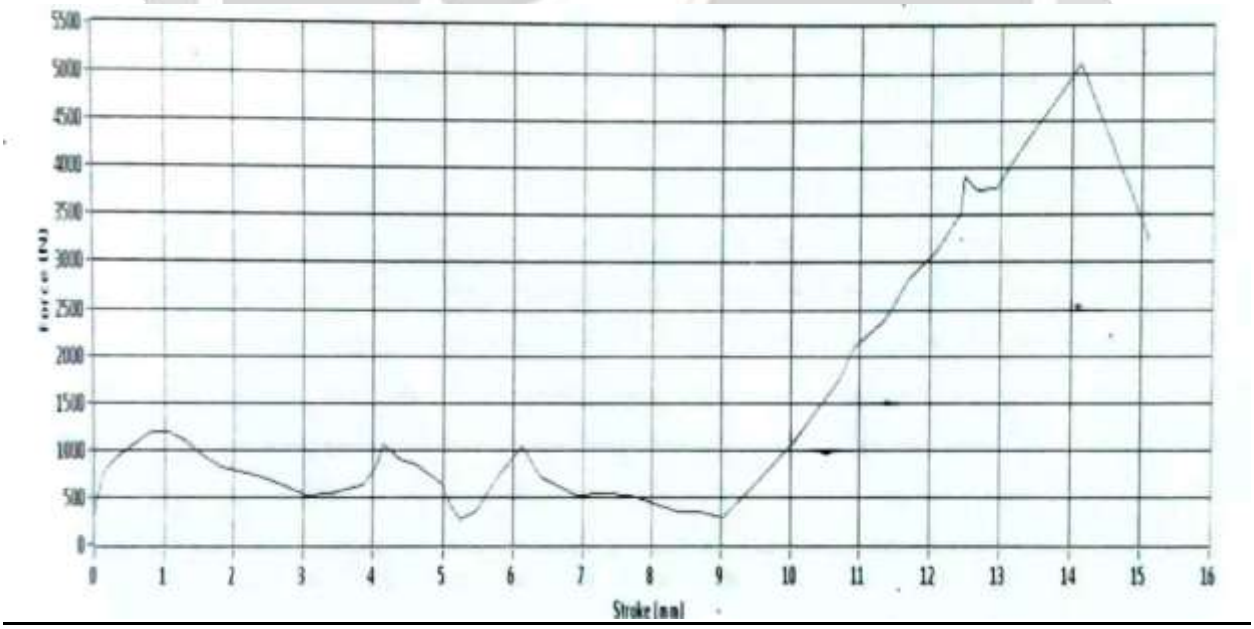
The measurement and input data of the material is mentioned below:

- *Thickness of material: 4.16 mm*
- *Width of the material:5.95 mm*
- *Area of the material: 24.75 mm^2*
- *Gauge length: 25.00 mm*
- *Final gauge length: 25.460 mm*

Result of tensile test:

- *Tensile strength: 206.17 Mpa*
- *Yield stress: 182.50 Mpa*
- *Elongation: 1.84 %*

Graph:



Compression Test:

The reinforcement material also undergoes with the compression test. By which the material is been placed. The test sample is loaded between the two plates and a force is applied to the sample by moving the crosshead toget her. During the test, the specimen is compressed and the deformation caused by the applied load is recorded.

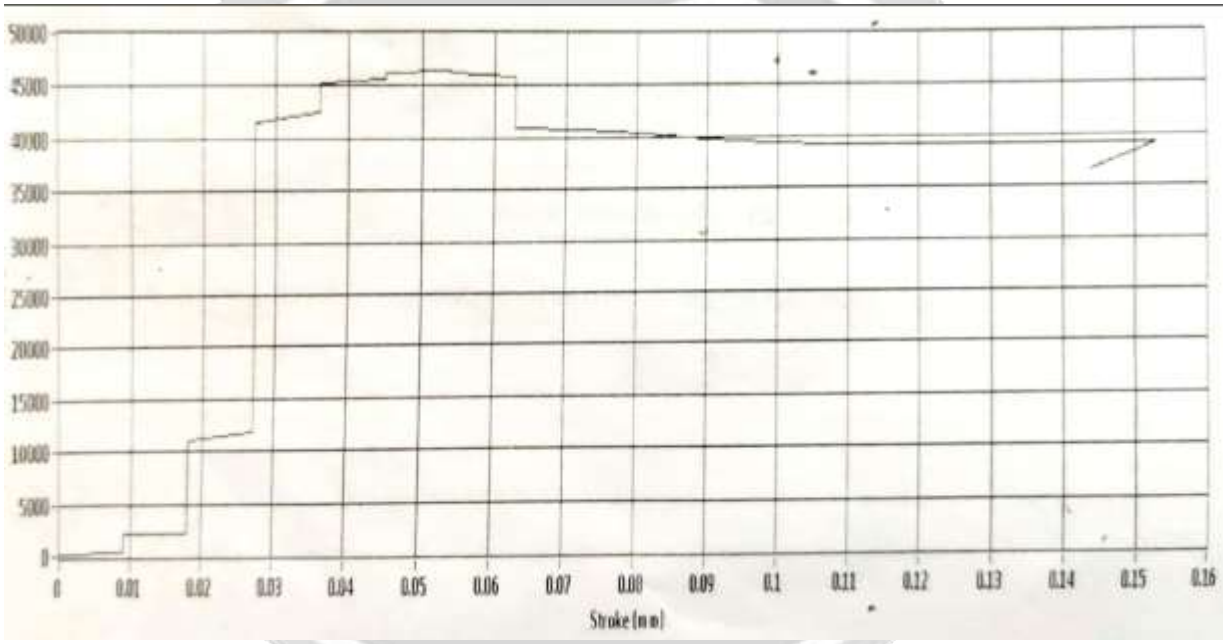
The measurement and input data of the material is mentioned below:

- *Thickness of the material: 6.16 mm*
- *Width of the material: 25.14 mm*
- *Area of the material: 154.86 mm^2*
- *Gauge length: 25.00mm*
- *Final gauge length: 0.000 mm*

Result of compression test:

- *Compression Load: 46.44 KN*

Graph:



<u>Impact Test:</u>

The Charpy impact test involves striking a notched impact specimen with a swinging weight or "tip" attached to a s winging pendulum. The sample breaks at its notched section on impact, and the upward swing of the pendulum is us ed to determine the energy absorbed.

The measurement and input data of the material is mentioned below:

- *Length of the material: 55 mm*
- *Width of the material: 10 mm*

Result of impact test:

Impact value: 2 Joules.

5. CONCLUSION

Aluminum 7075 reinforcement with 3% graphene is have been successfully processed by stir casting by itself Aluminium7075 and graphene gets strong and light weight material. When the two components well get combined their Physical and Chemical properties are get together to a one combined material. In These Modern Era the Need for composite material in the area of automobile, aerospace and aeronautics are very much Needed. So that the aluminum 7075 is strong material among the aluminum series when the graphene is added the material toughness, flexibility and high in resistance are increases in the reinforcement material and the place for the composite material used in the above-mentioned areas or from vehicle brake pad to vehicle body frame. In aerospace this material is used in aero plane wings. So comparing with normal AL 7075 material our reinforcement material have higher specification.

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