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"IMPROVE THE STRENGTH OF THE COMPOSITES METAL BY USING AL-TI C MATERIAL"

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ABSTRACT

In this project, Al based metal lattice composite materials are one of the significant composites effectively accessible with ease. These Al base composites improved quality, solidness, and wear opposition over unreinforced combinations. The aluminum-based alloy and its in-situ composites were prepared by liquid metallurgy route using graphite crucibles for melting. Electric resistance furnace was used for melting. The melting process was carried out in protective argon atmosphere. The base alloy was synthesized by melting pure commercial aluminum ingot and adding Mn, Mg, Cu, Ti, Pb,Al, Zn and Fe chips (purity 99.5 %) to meet the composition of 5083 Al alloy. Al alloy composites containing 5wt.% and 10wt.% TiC particles have been successfully synthesized by casting route using In-situ technique. The size of the TiC particles has been observed to be in the range of 1.00 to 5.00 micron. The compressive strength of the composites has been found to be higher than that of the matrix alloy. Further, the strength of the composite containg 10 wt. % TiC was observed to be higher than that of the composite containing 5 wt. % TiC. The strength of the alloy and composites improved significantly.

Key Words: *Strength, Al , Ti C, liquid metallurgy, in-situ, graphite crucibles, Electric resistance furnace*

I. INTRODUCTION

In present days each organization or Industry should rely on composite materials with a view to high reliability, low density and high cohesive wear resistance. These items are widely used in aircraft, automobiles, electronics and gadgets, as well as in the metal and clinical businesses. The composite metal material made of alti is one of the most important compounds that is easily accessible. These Al base compounds have improved quality, durability, and wear resistance in addition to the unconfirmed combination. However the final change of these compounds in construction is always mechanically connected by rotating the work around the machine operation where a piece of work is attached to its harp and cut into the type of chips by cutting metal by thinking of cutting boundaries, e.g. speed, feed, quantity cutting. Apart from that it is also a problem for a talented manager to do work with appropriate boundaries that benefits the best qualities and good qualities. Record recording is an excellent strategy for drawing positive qualities that reflect a positive economic situation, doing so helps us speak. Turn is restricted by cutting and counting parameters. Cutting parameters include the size of the cut, the feed and the size of the cut. From now on there is a need to improve the parameters of the cycle. The aim of the study was to find the development of a cycle to reduce land volatility, energy consumption and conversion time. The Plan Of Experiments (DOE) will be adopted and develop a combination of cycle parameters taken through the above response process. Development of cycle parameters using the development of Genetic Algorithm. Response Surface Methodology (RSM) and asset calculations are devices for measuring the show and finding the most logical attributes. 2. Coherent work This emphasizes the multiplicity of building materials and techniques for the creation of integration. Metal Matrix Composites (MMC) are advanced objects that come as a result of a combination of at least two objects where non-measurable structures are found. They are known for sensitive

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considerations as light for their high quality, durability, low durability [1-3]. 3. Materials It is used a wide variety of lattice cast aluminum and titanium amalgam to form compounds based on a variety of support materials that depend on their business performance. The combination of the Aluminum and Titanium steel frame is used for security, military, automotive and general design reason due to the buildings of their managers. Compounds are produced with extraordinary achievement through the use of fiber reinforcement materials in network metal equipment. A worrying point in the planning of MMC items is joining the attractive metal element and strengthening [2]. In reinforced MMC, the reinforcement molecule is integrated with a multi-object grid to aid in durability and quality. Applications produced by real loads, or larger warmer types, such a combination is better than any mechanical cycle [4 - 6].
The main task in this concept is to study the changes in thermal performance, mechanical properties and the small composition of aluminum alloy and aluminum alloy with 5% and 10 wt.% TiC is a combination of in-situ treatment. Aluminum alloy and compounds are formed by in-situ and re-melted in an electric furnace.
Aluminum: Aluminum is the most abundant metal in the world, and is the third most abundant element, behind oxygen and silicon. It makes up about 8% of the weight of the earth's solid surface. Due to its easy availability, high weight strength, easy machinabile, durability, high ductility and flexibility, aluminum is among the most useful metals. No matter where the metal is made, bauxite ore mines are concentrated in a few places in Australia, Brazil, Ghana, Guinea, India, Jamaica and parts of Russia and China. Worldwide, about 20 miles [30 km] of bauxite mines are opened up each year. The same location of the mines that have been completed for repairs, produces 100% complete renovation Some information about Aluminum:-

Aluminum alloys: Alloys used to increase strength and durability. Alloys are stronger than pure metal. Aluminum alloys with various properties are used in engineering
properties. Choosing the right alloy for a given system includes its strength, durability, durability, usability, efficiency, resistance to corrosion. Aluminum alloys are alloys where aluminum (Al) is a high quality metal. Common synthetic materials are copper, magnesium, manganese, silicon and zinc. There are two main categories, namely cast alloys and active alloys, both of which are divided into two categories of curable or thermal alloys. About 85% of aluminum is used in composite products, for example rolling plate, paper and extrusion.
Fruits of cast aluminum alloy are expensive products due to their low melting point, although they usually have lower strength strength than alloys combined. The most important aluminum alloy system is Al-Si, where high levels of silicon (4.0% to 13%) contribute to providing excellent casting properties.

II. METHODOLOGY

The aluminum-based alloy and its in-situ composites were prepared by liquid metallurgy route using graphite crucibles for melting. Electric resistance furnace was used for melting. The melting process was carried out in protective argon atmosphere. The base alloy was synthesized by melting pure commercial aluminum ingot and adding Mn, Mg, Cu, Ti, Pb,Al, Zn and Fe chips (purity 99.5 %) to meet the composition of 5083 Al alloy. The nominal compositions of the alloy and composites so synthesized are shown in Table 1. After adding the required wt. % of alloying elements, the melt was stirred thoroughly and degassed.

The aluminum alloy melt was poured into the pre heated permanent cast iron mold and allowed to solidify. The Al-TiC composites with two different volume fractions of TiC have been fabricated by in-situ SHS technique. Various processing steps in this case involved addition of Ti and C powder mixture to the alloy melt, allowing the reaction between the powder mixture to occur inside the melt forming TiC phase and pouring the melt in the mould. The pre-heated elemental powders of Ti and C were added into the alloy melt according to 5 and 10 wt. % TiC formations. After completion of the reaction, the melt was stirred with the help of a mechanical stirrer rotating at a speed of 500 ± 10 rpm and poured into the permanent mold. The pouring temperature of Al alloy and composites was 800± 5°C. All the castings made were in the form of 14 mm diameter and 170 mm length cylindrical rods. Figure 5 represents the processing flow chart for synthesizing the alloy &composite. The melting facility and castings made are shown in Fig. 2. The in-situ 5083Al-TiC composites were synthesized using self propagating high temperature synthesis process.

First we prepare the master composite of Al+20TiC (Titanium powder (<150 μm) and Graphite powder (<50 μm) were mixed by employing ball milling) and then prepare the composite with 5083-Al alloy. The 5083Al-TiC composite was

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synthesized in the furnace chamber under controlled Argon atmosphere. The Al+TiC master composite was added into the 5083Al alloy melt and stirred thoroughly. The 5083Al alloy composite melt was cast in the permanent mould.

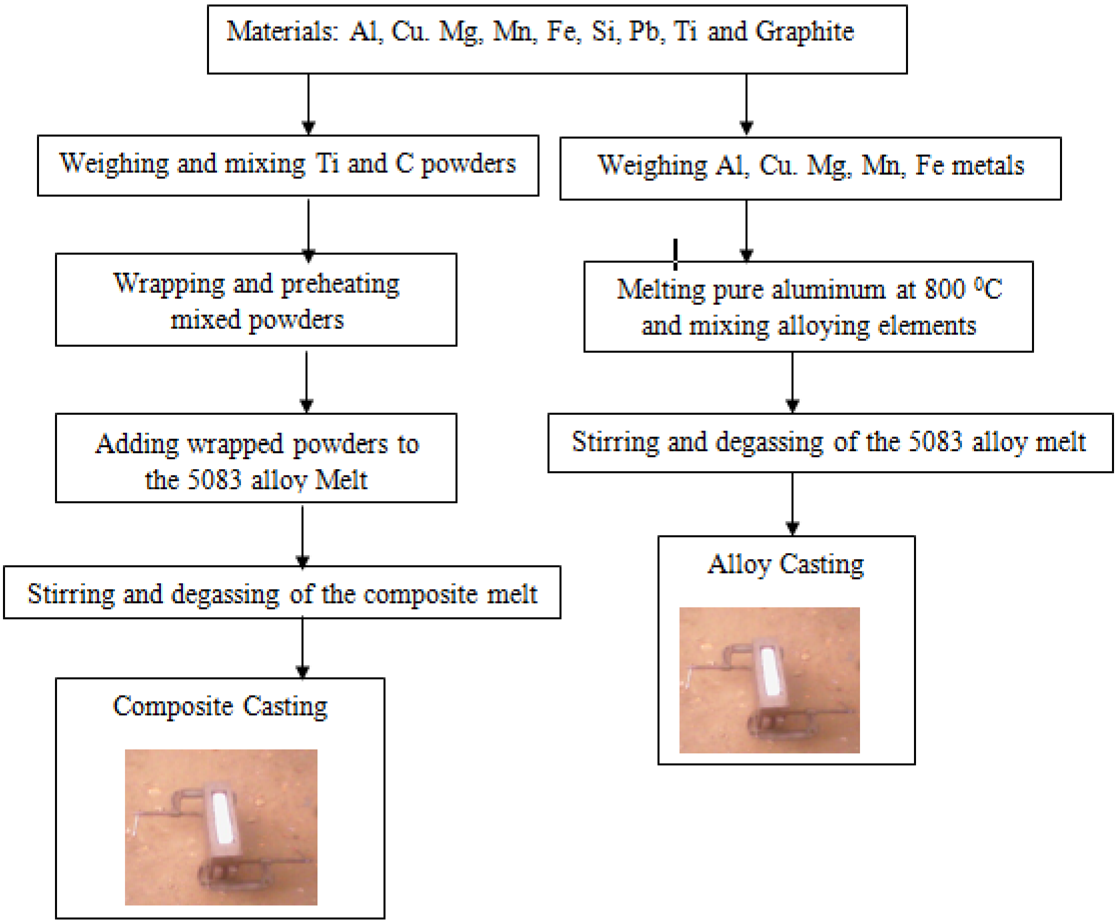

Figure.2.1: Flow chart of alloy and composite

Step 8- stop the simulator and exit from the experimental environment.

III. EXPERIMENTAL SETUP

3.1 Melting facility and castings

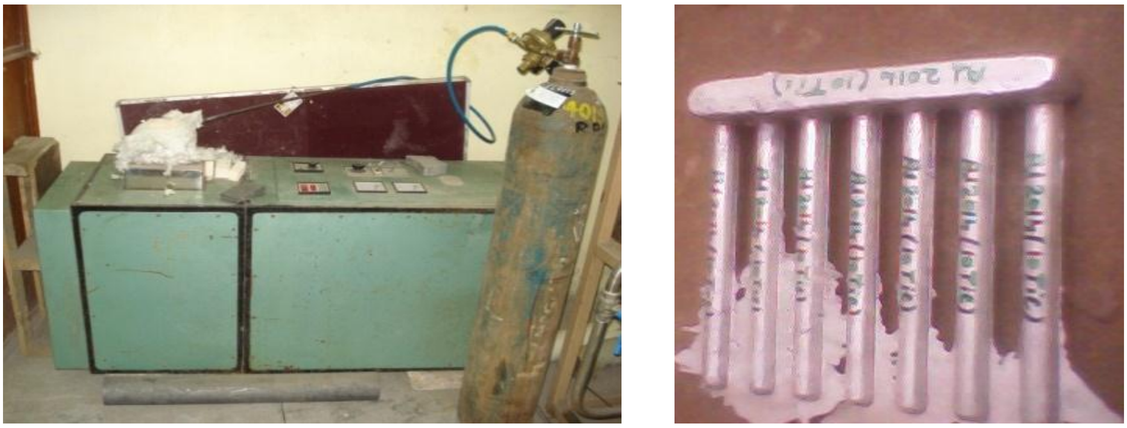

Figure.5.1: Melting facility and castings of Al-TiC Composites

After fabrication of in-situ Al-TiC composites the re-melting of alloys 5083, composite of TiC with 5 and 10 wt. %at 800 degree Celsius was done. The mechanical stirring, degassing with the nitrogen gas was done for proper mixing of micro TiC particles for about 5 minutes and then molten metal was cast in cast iron die which is pre-heated at 300 degree Celsius.

3.2 Testing Of Properties

3.2.1 Compression Test

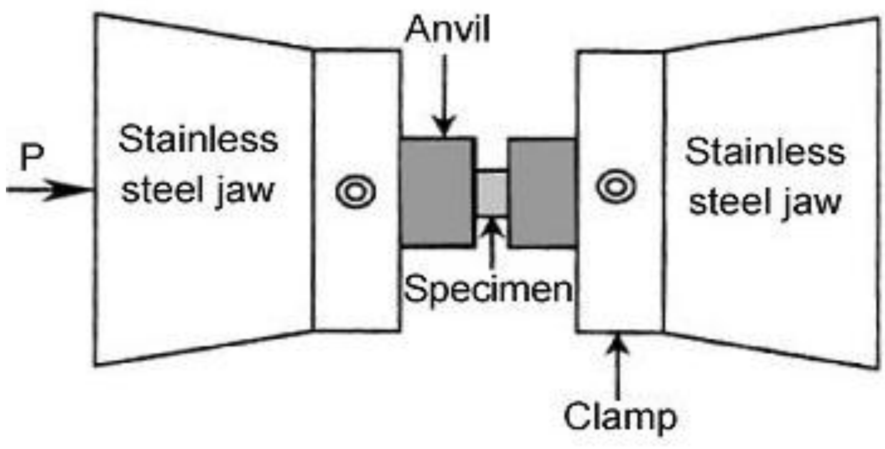

Figure3.2 Block Diagram of compression Test

Figure 3.3 Universal Testing Machine (UTM)

When a body is subjected to two equal and opposite axial compressive forces, then the stress induced in any section of the body is known as compressive stress. A little consideration will show that due to the compressive load, there will be an increase in cross section area and decrease in length of the body. The ratio of the decrease in length to the original length is known as compressive strain. This test is performed on a Universal Testing Machine. In this test the specimen is placed between the table and moving cross head. After the test, final diameter and the length are measured. Compression tests of the aluminum alloys and Al-TiC composites with 5 and 10 wt. % were done universal testing machine.The 5083 Al -5 wt. % TiC composite attained 252.2 MPa and 5083 Al-10 wt.% TiC composite attained ~

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Impact Factor : 3.805

285.8 MPa while the strength of matrix alloy was observed to be ~ 239.8MPa which is also shown in table below. The diameter of the circular rod is 6.62000 mm and length of specimen is 21.13000 mm.

Table 3.1 : Compressive stress of Al-5083alloy and composites

Materials	Compressive stress(MPa)
ASTM B241 matrix alloy **Aluminium Alloy 5083**	239.8
ASTM B241 Aluminium Alloy 5083 -5wt.% TiC	252.2
ASTM B241 Aluminium Alloy 5083 -10 wt.% TiC	285.8

Theses all above value find through physical testing machine by UTM

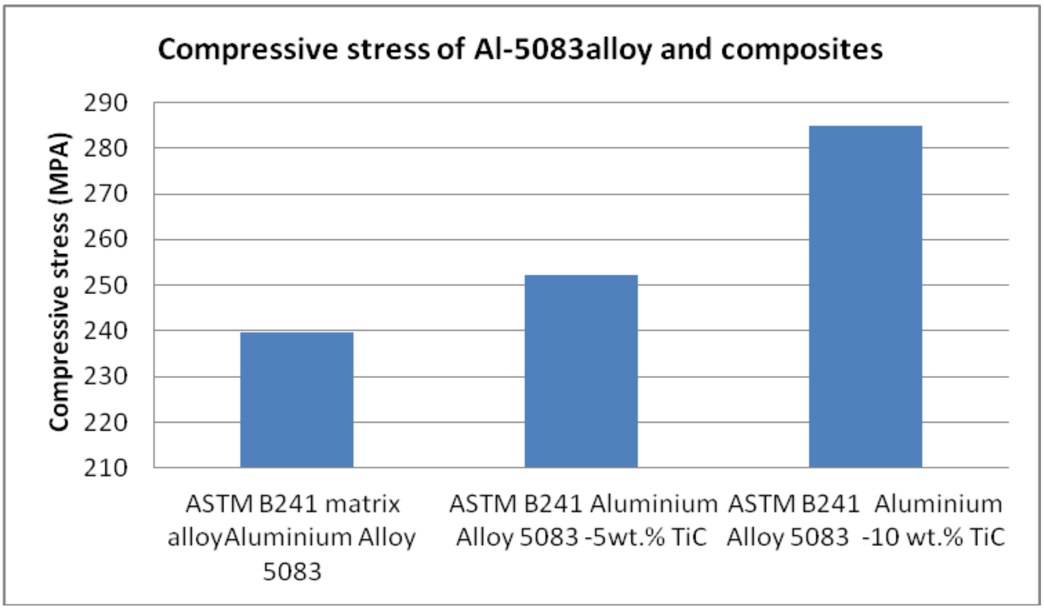

Figure 3.4 Compressive stress of Al-5083alloy and composites

3.3 Micro structural Analysis:

3.3.1 Scanning electron microscope (SEM):

In this scanning electron microscopic (SEM) a type of electron microscope that produces images of a sample by scanning with a focused beam of electron. The electrons interact with atoms in the sample, producing different signals that can be detected and its contain information about the sample surface topography and composition. The electron beam generally scanned in a pattern which is raster scan, and the beam position is combined with the detected signal to produce an image. SEM can achieve resolution better than 1 nanometer. Specimens can be observed in high vacuum, in low vacuum, in wet condition (in environmental SEM), and at a wide ranges of cryogenic or elevated temperatures. In the scanning electron microscopic the conductive materials grain size and its boundaries seen in micro level. In the non-conductive material before the SEM analysis the sample of non-conductive coating in fine coating unit and make its conductive then the sample ready for the SEM image of grain and grain boundaries.

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Figure.3.5: Open chamber Scanning electron microscope

In our thesis the Al alloys and of 5 and 10 wt.% TiC composite using the SEM to find the micro size image of grain and grain boundries. the microstructure of Al alloys and TiC composite .

3.4 Hardness Testing:

3.4.1 Testing of hardness by Vickers hardness test:

Graph shows the hardness values of Al 5083 matrix and itscomposites containing 5wt. % and 10 wt. % Ti C particles. The composites attained relatively higher hardness than that of the as-cast Aluminum alloy due to the grain refinement and homogeneous distribution of the particles. As it can be observed from the table that there is a increase in the hardness valve from alloy to composites.

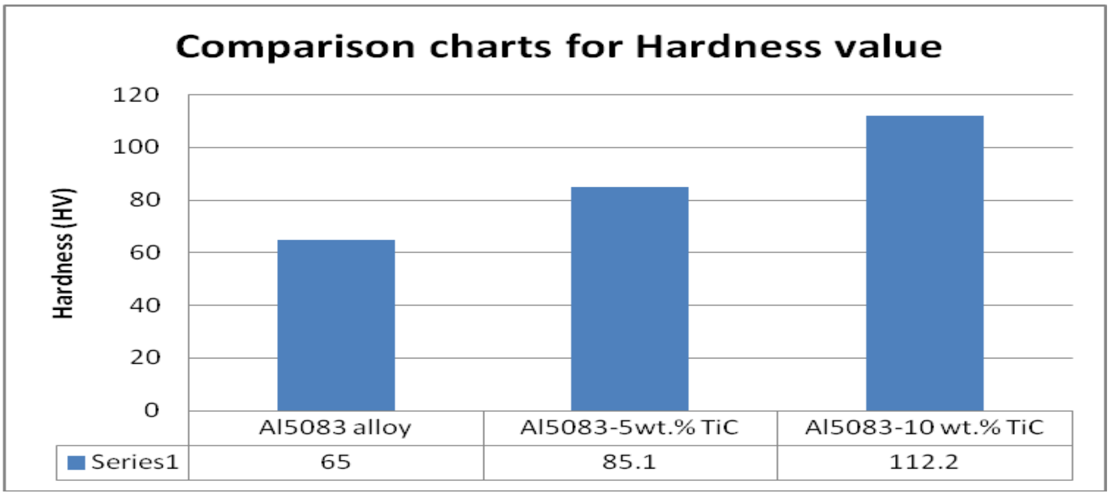

Figure 3.6 Comparison charts for Hardness value

3.5 **Microstructure**:

The aluminum alloy and composites has beensuccessfully synthesized using In-situ casting route. The TiC particles in the matrix have been observed to be in the range of 1 to 5 micron. However Clustering of particle was also observed at some location.

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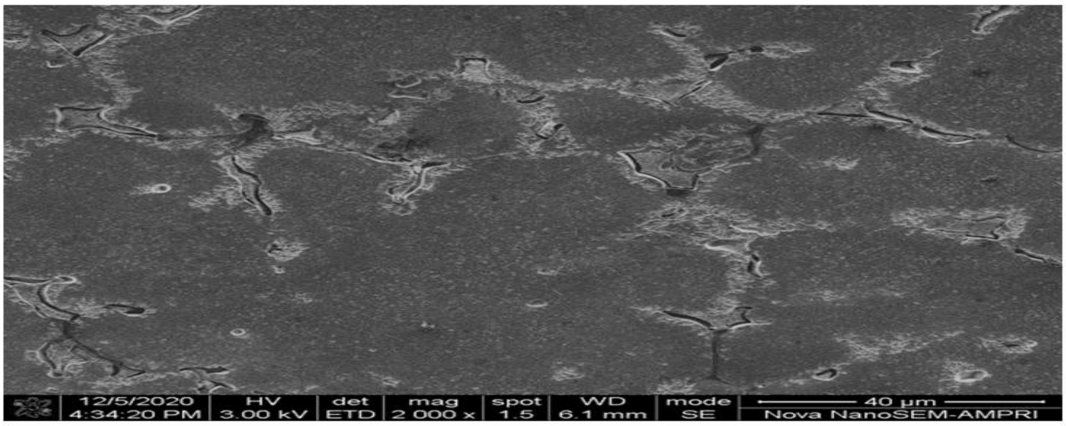

Figure 3.6 Micro-structure of Aluminum 5083

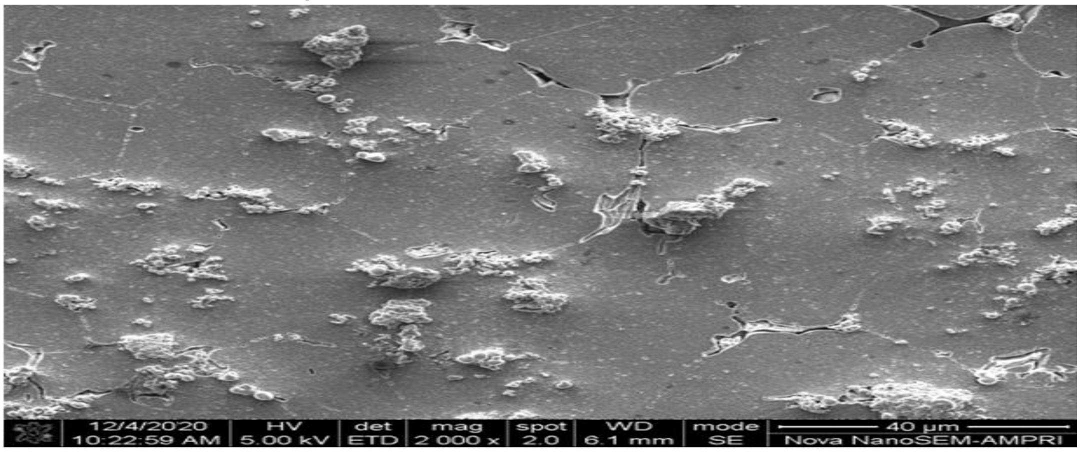

Figure 3.7 Micro structure of Aluminum 5083-5 wt.% TiC composite

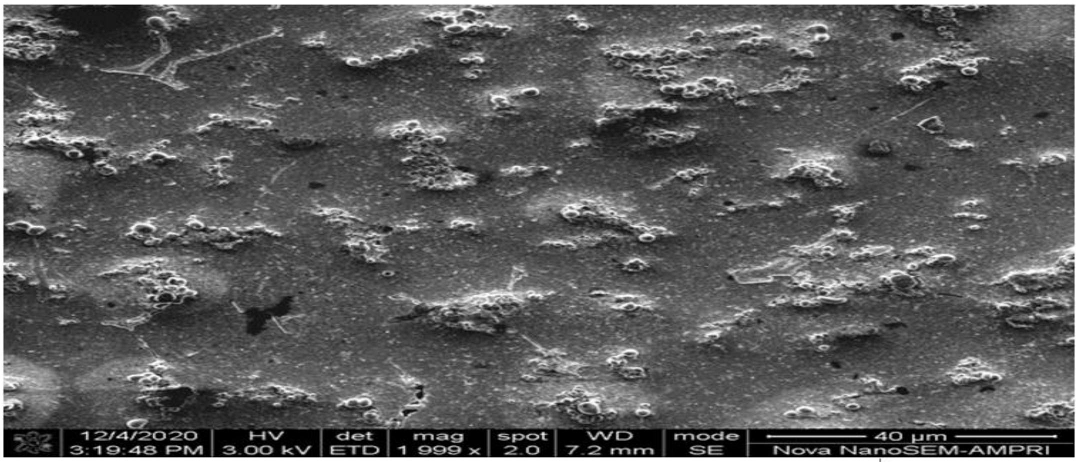

Figure 3.8 Micro-structure of Aluminum 5083-10 wt.% TiC composite

3.6 Compression Test:

Graph shows the compressive strength of aluminium alloy and composites. The strength of the composite is found to be higher than that of the matrix alloy. Further the strength of the composite containing 10 wt. % Tic than the 5 wt. % Tic is higher. The compressive strength of the composite was improved due to the in situ process.

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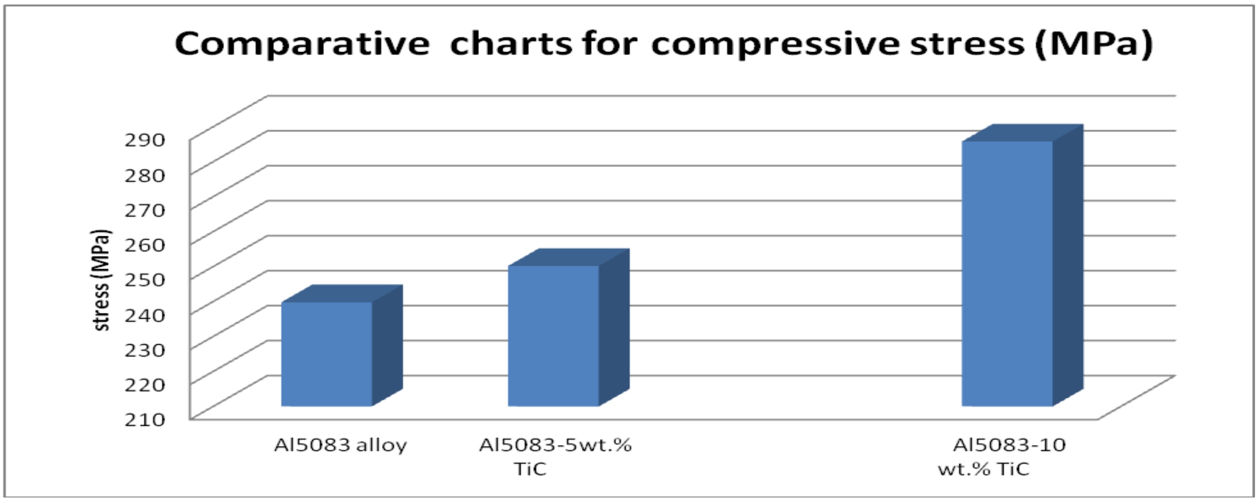

Figure 3.9 Comparative charts for compressive stress (MPa)

IV. CONCLUSION

The observations made in this investigation lead us to draw the following conclusions:

- Al alloy compositescontaining 5wt.% and 10wt.% TiC particles have been successfully synthesized by casting route using In-situ technique. The size of the TiC particles has been observed to be in the range of 1.00 to 5.00 micron.
- The compressive strength of the composites has been found to be higher than that of the matrix alloy. Further, the strength of the composite containg 10 wt. % TiC was observed to be higher than that of the composite containing 5 wt. % TiC. The strength of the alloy and composites improved significantly.
- The composites attained relatively higher hardness than that of the as-cast Aluminium alloy. The hardness of the alloy and composites improved due to the grain refinement and homogeneous distribution of the TiC particles in the Al alloy matrix.
- This study useful for application for heat exchanger tube making purpose.

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