2. LITERATURE REVIEW

L.M.Manocha & A.R. Bunsell, [1980] “Advances in Composite Materials” Coatings can also be used to tailor the bond strength between fiber and matrix. If adhesion between fiber and matrix is too good, cracks in the matrix propagate right through the fibers, and the composite is brittle. By reducing the bond strength, coatings can enhance crack deflection at the interface, and lead to higher energy absorption during fracture through fiber pullout mechanisms. Sometimes a coating is needed to promote wetting between the matrix and the fiber and thereby achieve a good bond. Graphite can be coated with titanium diboride in order to promote wetting, processing techniques, as well as coatings, can be used to control deleterious fiber/matrix interactions. The application of pressure can be used to force intimate contact between fiber and matrix and thus promote wetting; squeeze casting is one process that does this[11].

A.K.Dhingra, [1986] “Metal Replacement by Composite” The literature survey is carried out as a part of the thesis work to have an overview of the production processes, properties and wear behaviour of metal matrix composites. Composite structures have shown universally a savings of at least 20% over metal counterparts and a lower operational and maintenance cost[1].

T.G.Nieh et. al. [1990] “Microstructure and Deformation properties of an Al2O3-Ni3Al composite from room temp to 14000C” The combination of our new micro structural observations and Enami et al.’s electrical resistivity data allow us to tentatively conclude that the stable phase relations of Ti 50Pd(50–x) TMx (TM = vanadium, chromium, manganese, and iron; x = 0 to 30) are of eutectoid-type . Undistorted β2 (B2) persists throughout the elevated-temperature region, while at lower temperatures there are two different phases[21].

Greg Fisher [1992] “Composite: Engineering the ultimate material” Although it has traditionally been considered that ceramics do not suffer from fatigue, this view may have arisen partly because of the difficulty of carrying out fatigue tests on brittle materials and partly because fatigue phenomena may easily be obscured by the high level of variability associated with brittle failure. Certainly, fatigue crack growth phenomena have been observed in a variety of brittle materials and a range of mechanisms, including micro cracking, small-scale plasticity resulting from dislocation movements and stress induced phase transformations, have been invoked to explain the observations[5].

Nevertheless, although fine-scale effects such as these will certainly occur in ceramic matrix composites, especially those reinforced with particulate fillers or fine whiskers, the results of fatigue in continuous-fibre CMCs are on a much larger scale and are due largely to cracking[5].
K.Upadhya [1992] “Composite Materials for Aerospace Applications, Developments in Ceramic and Metal Matrix Composites” It is seen that for any material to be used in aerospace applications, certain criteria must be met. Although the exact set of required properties depend on the specific application, certain properties such as low density, good fatigue performance, and high wear and corrosion resistance are seen as universal requirements for effective functioning in the industry. Therefore, this paper makes a case for Al-SiC MMC and its application in the aerospace industry by exploring its properties. One of the main reasons for its consideration was the material’s low density and its good wear (and corrosion) resistance[9].

Y.Marchal et al. [Nov 1993] “Processing and properties of metal matrix composites reinforced with continuous Fibres for the control of thermal expansion, creep resistance and fracture toughness” Al-Zn and Cu-based matrix composites reinforced with continuous fibres of carbon, SiC, Al1203, or steel have been processed by squeeze casting or powder metallurgy. Interface reactions can be controlled by alloying additions in the matrix. Interface adhesion has been characterized from the distributions of fibre pull-out lengths on fracture surfaces. Thermal expansion curves reveal the magnitude of the stress transfer at interfaces. In the case of low melting point matrices, ductile steel fibres offer the best combination of fracture toughness and creep resistance[23].

C.O.Oriakhi [1998] “Nano Sandwiches, Chem. Br.” Jokhio, Panhwar & Mukhtiar Ali investigate the effect of elemental metal such as Cu-Zn-Mg in aluminum matrix on mechanical properties of stir casting of aluminum composite materials reinforced with alpha " Al2O3" particles using stir casting they found increase in tensile strength. Also they found that Mg has pronounced effect on aluminum cast composites up to 2.77% Mg contents which increases wet ability, reduces porosity and develops very good bonding with Al2O3 [3].

J.Hashim et al. [2001] “THE ENCHANCEMENT OF WETABILITY SiC PARTICLE IN CAST ALUMINIUM MATRIX COMPOSITE” Cast A356/SiCp composites were produced using a conventional stir casting technique by S. Tzamtzis, N. S. Barekar, N. Hari Babu, J. Patel, B. K. Dhindaw they found a good combination of improved Ultimate Tensile Strength(UTS) and tensile elongation is obtained[8].

M.K.Surappa [February/April 2003] “ALUMINIUM MATRIX COMPOSITES: CHALLENGES AND OPPORTUNITIES” Now days with the modern development need of developments of advanced engineering materials for various engineering applications goes on increasing. To meet such demands metal matrix composite is one of reliable source. Composite material is one of the reliable solutions for such requirement. In composites, materials are combined in such a way as to enable us to make better use of their parent material while minimizing to some extent the effects of their deficiencies. The simple term ‘composites’ gives indication of the combinations of two or more material in order to improve the properties. In the past few years, materials development has shifted from monolithic to composite materials for adjusting to the global need for reduced weight, low cost, quality, and high
performance in structural materials. Driving force for the utilization of AMCs in areas of aerospace and automotive industries include performance, economic and environmental benefits[14].

M. K. Surappa [February/April 2003] “ALUMINIUM MATRIX COMPOSITES: CHALLENGES AND OPPORTUNITIES” The use of organic or inorganic filler has become ubiquitous in polymeric systems. Polymer composites are manufactured commercially for many diverse applications such as sporting goods, aerospace components, automobiles, etc. In the last 20 years, there has been a strong emphasis on the development of polymeric nanocomposites, where at least one of the dimensions of the filler material is of the order of a nanometer. The final product does not have to be in nanoscale, but can be micro- or macroscopic in size[15].

This surge in the field of nanotechnology has been greatly facilitated by the advent of scanning tunneling microscopy and scanning probe microscopy in the early 1980s. With these powerful tools, scientists are able to see the nature of the surface structure with atomic resolution[15]. Simultaneously, the rapid growth of computer technology has made it easier to characterize and predict the properties at the nanoscale via modeling and simulation[15].

S. Naher et.al, [2003] “SIMULATION OF THE STIR CASTING PROCESS” The blade angle and number of blades are prominent factor which decides the flow pattern of the liquid metal at the time of stirring. The blade with angle 45° & 60° will give the uniform distribution. The number of blade should be 4. Blade should be 20mm above the bottom of the crucible, Blade pattern drastically affect the flow pattern [20].

T.W.Clyne [2003] “Types and Developments in Comprehensive Composite Materials” Metal matrix composites constitute a new class of materials, now starting to make major industrial impact in fields as diverse as aerospace, automotives and electronics. There are many interdependent variables to consider in designing an effective MMC material. Since the upper bound on MMC properties is established by the properties of the matrix and reinforcement material, careful selection of these components is necessary[22].

Nanoscience and Nanotechnologies [July 2004] “The Royal Society & the Royal Academy of Engineering” The cost of the component production by solid state processing route was still high and hence large scale commercialization of wide spectrum of engineering component did not take place. The commonly used reinforcement is silicon carbide particulates (SiCp) in cast alloy matrix (modified compositions of 356 and 357 Al alloys) and alumina particulates in wrought alloy matrix (6061/2024). Even though the possibilities of using different kinds of reinforcement in Al alloys as reinforcements, except SiCp and A1203 others have not shown any commercial potential [17].

N.Hari Babua, et.al. [2008] “Fabrication of Metal Matrix Composites under Intensive Shearing” A new novel rheo-process has been developed to fabricate metal
matrix composites with uniform microstructures and without formation of particulate agglomerates. This rheo-process is based on intensive shearing of liquid metal containing particulate clusters. Intensive shearing is observed to disperse the agglomerates into individual particle within the alloy matrix and solves the most significant problem (i.e, the difficulty of achieving a homogeneous distribution of reinforcement in the matrix composites) associated with the production of MMCs. We have demonstrated that processing of MMCs containing as low as 1-5 μm sized SiC particulates without the presence of clusters, but with good distribution using a liquid processing route, is achievable. In addition to homogeneous microstructures, overall processing steps to produce Rheo-MMC are significantly low, when compared to that of commonly employed industrial process[16].

M. N. Wahab et al. [2009] “PREPARATION AND CHARACTERIZATION OF STIR CAST-ALUMINUM NITRIDE REINFORCED ALUMINUM METAL MATRIX COMPOSITES” Preparation and characterization of aluminum metal matrix composites reinforced with aluminum nitride was carried out by M. N. Wahab, A. R. Daud and M. J. Ghazali they found considerable significant increase in hardness of the alloy matrix[13].

In Yup Jeon and Jong-Beom Baek [May 2010] “Nanocomposites Derived from Polymers And Inorganic Nanoparticles” Polymers are considered to be good hosting matrices for composite materials because they can easily be tailored to yield a variety of bulk physical properties. Moreover, organic polymers generally have long-term stability and good processability. Inorganic nanoparticles possess outstanding optical, catalytic, electronic and magnetic properties, which are significantly different their bulk states. By combining the attractive functionalities of both components, nanocomposites derived from organic polymers and inorganic nanoparticles are expected to display synergistically improved properties. The potential applications of the resultant nanocomposites are various, e.g. automotive, aerospace, opto-electronics, etc. Here, we review recent progress in polymer-based inorganic nanoparticle composites[24].

Dunia Abdul Saheb [Oct 2011] “ALUMINUM SILICON CARBIDE AND ALUMINUM GRAPHITE PARICULATE COMPOSITES” Experiments have been conducted by varying weight fraction of SiC, graphite and alumina (5%, 10%, 15%, 20%, 25%, and 30%), while graphite weight fraction 2%, 4%, 6%, 8% and 10% keep all other parameters constant by Dunia Abdul Saheb they found that an increasing of hardness and with increase in weight percentage of ceramic materials[4].

Hartaj Singh et al. [2011] “Pan overview of metal matrix composite: processing and sic based mechanical Properties” The most striking feature of silicon carbide is its polytypism, i.e. formation of a great number of structural changes without any change in composition. Although this feature of silicon carbide was extensively studied, no
A systematic up-to-date analysis was done. The widely used reinforcing materials for these composites are silicon carbide, aluminum oxide, and graphite in the form of particles or whiskers. The ceramic particles reinforced aluminum composites are termed as new generation materials and are tailored and engineered with specific required properties for specific application requirements. However, Al-SiC alloys based MMC provides significantly enhanced mechanical properties, high wearing resistance of the SiC/Al alloy composite is due to added SiC whiskers to the aluminum matrix and the aluminum diffuses into the SiC whisker, which leads to a high bonding strength between the whisker and matrix[7].

Muhammad Hayat Jokhio, et.al, [Jan 2011] “MANUFACTURING OF ALUMINUM COMPOSITE MATERIAL USING STIR CASTING PROCESS” Jokhio, Panhwar & Mukhtiar Ali investigate the effect of elemental metal such as Cu-Zn-Mg in aluminum matrix on mechanical properties of stir casting of aluminum composite materials reinforced with alpha "Al₂O₃" particles using stir casting they found increase in tensile strength. Also they found that Mg has pronounced effect on aluminum cast composites up to 2.77% Mg contents which increases wettability, reduces porosity and develops very good bonding with Al₂O₃[12].

G. G. Sozhamannan et.al. [2012] “EFFECT OF PROCESSING PARAMETERS ON METAL MATRIX COMPOSITES: STIR CASTING PROCESS” Along that graphite will not react with aluminum at these temperature. This crucible is placed in muffle which is made up of high ceramic alumina. Around which heating element of wound. The coil which acts as heating element is Kanthol-A1. This type of furnace is known as resistance heating furnace. It can work up to 900°C reach within 45 min. Aluminium, at liquid stage is very reactive with atmospheric oxygen. Oxide formation occurs when it comes in contact with the open air. Thus all the process of stirring is carried out in closed chamber with nitrogen gas as inert gas in order to avoid oxidation. Closed chamber is formed with help of steel sheet. This reduces heat loss and gas transfer as compared to open chamber[6].

K. Gawadzinska [2013] “Quality features of metal matrix composite castings” These features (pertaining to a set of quality characteristics of composite castings) have been named as specific, they have not been determined yet and a description of material quality should be performed (according to the qualitology) on a principle of description of quality characteristics of this product. Therefore, this set of features has been determined. It was proposed to add the following characteristics to the set of specific features of composite castings quality: matrix material, reinforcement material, binding between components and porosity of the composite casting. In this set a sub-set of quality characteristics of composite castings was also determined[10].

Rajeshkumar Gangaram Bhandare and Parshuram M. Sonawane [Dec 2013] “Preparation of Aluminium Matrix Composite by Using Stir Casting Method” The basic reason of metals reinforced with hard ceramic particles or fibers are improved properties than its original material like strength, stiffness etc. Stir casting process is mainly used for manufacturing of particulate reinforced metal matrix
composite (PMMC). Manufacturing of aluminum alloy based casting composite by stir casting is one of the most economical method of processing MMC. Properties of these materials depend upon many processing parameters and selection of matrix and reinforcements. This paper presents an overview of stir casting process, process parameter, & preparation of AMC material by using aluminium as matrix form and SiC, Al₂O₃, graphite as reinforcement by varying proportion [19].

B.C. Pai et.al [2013] “LIGHT METAL MATRIX COMPOSITES – PRESENT STATUS AND FUTURE STRATEGIES’ All these examples illustrate that it is possible to alter several physical properties of aluminium/aluminium alloy by adding two or three appropriate reinforcement in suitable volume fraction.

Reinforcing the matrix with whiskers, short fibers or particulates of ceramics could give a composite improved properties compared to monolithic base alloy. Further, the attractive feature is the isotropic nature of the properties. Even though the property improvements are not as high as those achievable with continuous fiber ones, they are sufficiently attractive enough for most of the intended engineering applications [2].

Pradeepsharma et al. [2013] “PRODUCTION OF AMC BY STIR CASTING- AN OVERVIEW” In a stir casting process, the reinforcing phases are distributed into molten matrix by mechanical stirring. Stir casting of metal matrix composites was initiated in 1968, when S. Ray introduced alumina particles into an aluminum melt by stirring molten aluminum alloys containing the ceramic powders. Mechanical stirring in the furnace is a key element of this process. The resultant molten alloy, with ceramic particles, can then be used for die casting, permanent mold casting, or sand casting. Stir casting is suitable for manufacturing composites with up to 30% volume fractions of reinforcement [18].