CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF STUDY

Composite materials are important engineering material due to their outstanding mechanical properties. Composite material that exists today can be classified into five classes. Metal Matrix Composite (MMCs) is two material composite and being one material. One being a material necessity and the other material is different. Each of the material retains its characteristics and structure but the composite possesses better properties. Due to the high cost and difficulty of processing these composites led to the development of discontinuously reinforced composites.

The familiar material used nowadays is aluminum matrix composite (AMCs) because it has a low melting point, low density, high stiffness, and corrosion resistance. AMCs widely uses in the field of automation because of their properties. Aluminum (Al) is an abundant, because of their properties are light and strong. The metal matrix, the reinforcement material, the volume of the reinforcement and the fabrication method can all be diverged to achieve required properties.

Referable to improvement in wear resistance, stiffness, hardness, strength and chemical compatibility with Al, Silicon Carbide (SiC) is regarded an ideal reinforcement. A significant reduction of the fracture toughness and ductility of the MMCs due to the incorporation of the ceramics SiC has been reported by (Samuel 1993). This reduction in toughness is attributed (Samuel 1993) to the inhomogeneous distribution of the SiC particles,
presence of voids and weak interfacial bonding of Al-SiC. SiC has a strong bonding because of the composed of tetrahedral of carbon and silicon atoms. Due the strong bond it will produce a very hard and strong material. The properties of SiC are low density, low thermal, low density and high hardness. That's why the MMCs is the familiarity material uses in the modern day in industry automation.

While using isotropic properties, the MMCs is easily adaptable in engineering design. MMCs have considered promising candidates to fill these needs. In particular, particulate MMCs have been preferred over continuously reinforced MMCs because they avoid problems such as fiber damage, microstructural non uniformity and fiber contact damage (Ram Prabhu, Varma et al. 2014). MMCs reinforced with ceramic have been developed and applied in numerous industrial applications from automobile to the recreation industries. MMCs have been used in various industries because of the high strain rate impact properties, high specific strength, high stiffness, high resistance and reduced weight. MMCs usually consists low density, compared with unreinforced it has a high strength, high stiffness and wear resistance. The advantages of composite material are to increase yield strength and stress, and improve corrosion resistance. To improve the Al metal, the SiC needs to composite with Al. MMCs generally consists of lightweight. SiC particles and Al matrix is the main composite in the preparation of MMCs because of the physical and chemical compatibility.

Therefore, the reinforcement of metal matrix composite can be fabricated by powder metallurgy (PM), ingot metallurgy (IM), and disintegrated melt deposition (DMD) method. In this study, the PM method is carried out to fabricated SiC particle reinforced Al MMC. The effect of weight percentage of the reinforced particles on mechanical behavior such as microstructure of the composites and hardness can be investigated. The PM method is generally preferred because of the advantages. Due to the advantages of the PM method the uniformity distribution of ceramic particle reinforcement is realized. Powder metallurgy is a forming process consist of producing metal powder, blending, compacting in dies and sintering. The PM method also capable producing a relatively economically specimen and wide variety of metal matrix composite. Basically, in the conventional PM production, after produced the raw material, there are three steps consists. Firstly, the raw material are mixing
and blending. Then the material are compact into the circle shape using die. The last steps of PM method is sintering. This process is to cause solid state bonding of the particles and strength which involves heating to a temperature below the melting point. Mixture refers, when the powders have same chemical composition but different chemistries being combine. After that, in compaction, the high pressure is applied to the powders to form the material into circle shape. After compaction, the green compaction are lacks strength and hardness. The sintering process is applied as a heat treatment on the compact to bond the particles.

1.2 PROBLEM STATEMENT

MMCs is one type of composite that combination of solid that consist of two or more different materials that will reinforcement together. Each composite can enhance the mechanical properties such as the hardness, tensile strength and yield strength. In this situation, the problem occurs when its structure of the composite material, aluminum (Al) and Silicon Carbide (SiC) is crack earlier due the increasing of particles. When particles increase the mechanical properties of Metal Matrix Composite (MMCs) will become reduces. The crack grows due the increasing of particles. In addition, by using the nano-sized SiC particle reinforcement, the hardness, strength and the yield strength of the composite increase. The MMCs fracture initially as the crack breaks the particle and propagate. Therefore, the overall mechanical properties of the MMC reduced. So the reduction of the size of the particle can be a solution to increase the life of MMC. This is because when it is below the critical level, particles will no longer fracture. (Taha et al 2003) described, after break up, the ductile Al matrix is able to flow between the particles. The SiC need to redistribute in a more homogeneous configuration. The SiC particle size and distribution, the voids must be understood to optimize the suitable parameters for various applications.

The uniformity or homogeneous distribution of particle is also very important to get a good mechanical response of the composite (Kung et al. 2009). There are many types of method that can be used to manufacture the Al-SiC MMC. Most of the methods have a nearly uniform distribution of the reinforcement particle within the matrix. However, there are still some small agglomerations between it (Saravanani et al. 2015). To reduce the agglomerations, the powder metallurgy method is used. This method can help to have a