CHAPTER 1

INTRODUCTION

1.1 BACKGROUND STUDY

When the two or more dissimilar material combined physically and chemically it was called composite material. The reinforcing component is distributed in continuous or matrix components. These combinations are known as metal-matrix and ceramic-matrix composite. Metal matrix composite (MMC) is named when the matrix used is metal. Aluminium, titanium, copper and other super alloys are the common used metal in a metal matrix composite. While the fiber materials is graphite, silicon carbide, tungsten and boron. The composite materials significantly improve the strength, stiffness, weight and toughness.

As said before, the matrix-metal composite is the combination of matrix metal and fiber material. So, the matrix is the monolithic material into which reinforcement is embedded and it is completely continuous. It means, there is a path through the matrix, unlike two materials sandwiched together. Usually, a lighter metal have been used as a metal matrix which gives a flexible support to the reinforcement. The fiber material is embedded into the matrix. The fiber material usually act as a reinforced which improve the physical performance of material such as wear resistance, thermal conductivity and friction coefficient.
In this project, the metal matrix used is aluminum and the fiber material is silicon carbide. So, when these two components combined it will be form as aluminum-silicon carbide (Al/SiC) composite. The Al/SiC designed specimens will be prepared by using powder metallurgy technique. There are three basic steps namely, mixing powder according to its pre-designed, blending and compact pre-mixing powder, and lastly is sintering. The blended powders are then press and compact into a die. A die with specific dimension will be used for powder compaction at room temperature. After the compaction complete it will goes to the sintering process with the specific temperature.

This powder metallurgy technique offers good dimensional control and the finishing operation can be eliminates. Even though this process is having high cost in tooling it can reduces scrap and waste.

1.2 PROBLEM STATEMENT

When these two different materials combined, with large contrast in material properties are bonded, there are many defects and failure will occur during fabrication and operation. The three basic process to produce this Al/SiC composite is by using powder metallurgy involve are mixing the materials, blending and compaction, and lastly sintering. The problems are usually occurs during the sintering process because of the aluminum has low melting point while silicon carbide has high melting point. So, these two dissimilar materials cannot perform well during sintering process.

1.3 OBJECTIVES

The aim of this study was to improve the defects and failure that will occur during fabrication and characterization by using the powder metallurgy process. The study objectives include:

i) To design and fabricate the metal-matrix composite, namely Aluminum-Silicon Carbide (Al/SiC) system by using powder metallurgy process.

ii) To characterize the fabricated Al/SiC composites.
iii) To understand the effect of ceramic composition on the behavior of Al/SiC composite material under various compaction load.

1.4 SCOPES

In this project, the Al/SiC composite specimen will be fabricating by using the powder metallurgy process. The basic process are involving three steps which are; mixing and blending the powder, compaction, and sintering. On the mixing the metal and the ceramic powder process, there are few parameter will be monitored. Same goes to the compaction of metal powder and sintering which have their own parameters that will be monitored for example, temperature and compaction load.

When the powder metallurgy process had completely done, the process of characterization must be done. This process is carrying out by using an optical microscope. It was conducted to study the distribution of ceramic reinforcements in the designed specimen. The Al and SiC element in Al/SiC microstructure must be recognizes.

After doing the characterization process, there was the mechanical testing to be done. The effect of weight percentage of ceramic concentration of the composite can be investigated by using micro-hardness test. The micro-hardness test is conducted commonly by using the Vickers Hardness Tester.