CHAPTER 1

INTRODUCTION

1.1 BACKGROUND OF THE STUDY

Advanced materials are essential to technological development and intensify structural substances are particularly essential to aerospace system advancements. There are considerably requesting circumstances need that the new materials are stronger, harder, hotter and lighter (Processes et al., 1992). Nowadays, alloying material has been broadly investigate due to its characteristics that makes them encouraging candidates for a new generation of high production alloys. Alloying material exhibit circumstance which are appreciable attention for theoretical research (Bihlmayer et al., 1993).

Aluminium is one of the alloy that are widely used as an alloy due to its properties and behaviors. Development of high strength Aluminium alloys for use at moderate temperature is of great interest as substitute of nickel abased alloys in some engineering applications. This high performance alloy is called superalloys are high temperature materials which display excellent mechanical strength and resistance to thermal creep deformation and good surface stability.

The remarkable performance of today's superalloys is not merely fortuitous. Numerous researchers and technologists have worked to develop the basic understanding of their physical behaviour and the more practical aspects required to put these alloys to best use. It turns out that the topics of alloy design, process development, component engineering, lifetime estimation and materials behaviour are very closely inter-related.

In most circumstances, there are many methods in producing alloy which are agate mortar-pestle grinding, mechanical alloying, casting, forging, reaction sintering and hot isostatic pressing. Mechanical alloy is the most famous method in making alloy since it is low cost and it can produce alloys and microstructures that are not possible to produce by standard metallurgical practices.

Grinding of materials are complex techniques which depend on many influences (Bégin-Colin et al., 2000), for example on physical and chemical parameters such as temperature, nature of the grinding atmosphere, chemical composition of the powder mixtures, chemical nature of the grinding tools (Cao, 2016), are still in debate. High-energy ball milling process has captivated much deliberation and encouraged numerous research interests because of its promising outcomes, several applications and prospective scientific profit.

1.2 STATEMENT OF THE PROBLEM

Recently, the problem of the material nowadays is that, researcher always investigate to find better alloy with good mechanical properties and low cost that can be used in many kind of application in industry. In this proposed research, the main idea is to investigate the microstructure and mechanical properties of Ni-Al intermetallic alloy by agate mortar-pestle grinding techniques with different composition. Experimental and modelling studies of intermetallic keep growing since the properties of nickel-aluminium alloy, in addition to the intermetallic nature are attractive.

1.3 OBJECTIVES OF THE STUDY

Three (3) main objectives in this proposed research:

1. To prepare nickel-aluminium alloy by using grinding techniques.
2. To determine the effect of composition on microstructure and morphology of the nickel-aluminium intermetallic alloy.
3. To study the mechanical properties of nickel-aluminium intermetallic alloy at different composition.

1.4 SCOPE OF THE STUDY

In this research, two sorts raw material of metals which are aluminium and nickel, will be used to produce alloy namely Nickel-Aluminium intermetallic alloy by using agate mortar-pestle grinding. The Ni-Al intermetallic alloy will be mixed at different composition which will produce $NiAl_3$, NI_2Al_3, NiAl, Ni_5Al_3 and Ni_3Al. Then, the Ni-Al intermetallic alloy will be prepared as pellet and sintered before being characterized by using X-ray Diffractometer (XRD) and Scanning Electron Microscope (SEM).

For XRD, it will be used to identify crystalline species in a material (Engineering, 2016) and SEM will be used to reveals information of morphology and the microstructure of materials. In addition, direct measurement of volume was used to calculate different density of Ni-Al intermetallic alloy before and after being sintered. Effect of different composition of nickel and aluminium on mechanical properties were also investigated by Vickers Hardness testing.

1.5 ORGANIZATION OF THE THESIS

From a brief of introduction about intermetallic alloys, Chapter 1 presents problem statement, research objectives and scope of research. Chapter 2 reports an overall review on the previous research of Nickel-Aluminium intermetallic alloy and production based on its properties. This chapter also cover about grinding technique and heat treatment that will be used in this research. Chapter 3 represent the experimental method used in this work and the working principle of the instruments used for characterization. Chapter 4 discuss the synthesis and the characterization of Ni-Al intermetallic alloy with different composition that producing $NiAl_3$, Ni_2Al_3, NiAl, Ni_5Al_3 and Ni_3Al. Lastly, the summary of this research and recommendations for future work are given in Chapter 5.