

## Fabrication and Mechanical Behaviour of Al-6061/Al<sub>2</sub>O<sub>3</sub> Metal Matrix Composite Fabricated Through Powder Metallurgy Technique

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### ABSTRACT:

Aluminium-based composites exhibit better mechanical properties in automobile and aircraft industries. Al 6061 alloys have promising machinability and fracture toughness. Al<sub>2</sub>O<sub>3</sub> is used as reinforcement and added with Al-6061 alloy. In this work, various processing methods such as stirring, compacting and heat treatment have been attempted through the powder metallurgy method. The reinforcement for the alloy is 3%, 6%, 9% and 12% by weight. Four samples were prepared for the composite. The application of pressure for the sample during compacting is calculated. After compacting, the heat treatment process is carried out.

### KEYWORDS:

Metal matrix composites; Reinforcements; Powder metallurgy; Hardness

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## 1. Introduction

For the past decades, many researchers have attempted to transfer monolithic materials to composite materials. This is because of their unique performance, such as lightweight, strength, toughness and capable of performing better results in high and low-temperature applications [1]. Powder metallurgy is a method that produces excellent compositions of metallurgical structures. The compositions and structures cannot be produced other than solid and liquid state processing. The compositions yield better strength, corrosion resistance and fracture toughness. In this powder metallurgy, interfacial bonding between the reinforcement and parent material causes various defects. To overcome this bonding failure, proper stirring and compacting need to be carried out. Heat treatment is applied to enhance the quality of the samples. Many researchers are focusing on the interfacial bonding between reinforcements and matrix alloy. Aluminium 6000 series alloys have major elements such as magnesium and copper which are stimulating the properties during artificial ageing.

The addition of reinforcement to base metal will give different properties which can be controlled by various secondary processes such as extrusion and heat treatment. The selection of reinforcement to matrix alloy is an important factor for analysing the behaviour of composites. The formation of nucleation would decrease the properties of developed composites particularly this nucleation would affect the hardness of the sample. A powder mixture is obtained by adding one or more

members. In powder metallurgy process, selected solid lubricants, alloying powder and a binder to an iron powder are stirred with heating to a temperature not lower than melting point of the binder. Subsequent stirring is required at the same temperature. Then the mixture is stirred with cooling from the temperature and to obtain the powder mixture [2]. By this method, mixing can be efficiently conducted at a low cost.

## 2. Fabrication

Aluminium alloy of 6061 with particle size of 30 microns and the reinforcement of Al<sub>2</sub>O<sub>3</sub> with particle size of 10 microns are selected. Table 1 shows the chemical compositions of Al6061. Al<sub>2</sub>O<sub>3</sub> reinforcements with weight fraction of 3%, 6%, 9% and 12% were mixed with aluminium powders followed by a ball milling process for about 2 hrs at 200 rpm. The compacting process is carried out with an applied pressure was 90MPa. The sintering process is carried out to extrude the samples at 400°C. Fig. 1 shows the steps of the fabrication. After the extrusion process, the samples are air-cooled and testing of samples is initiated.

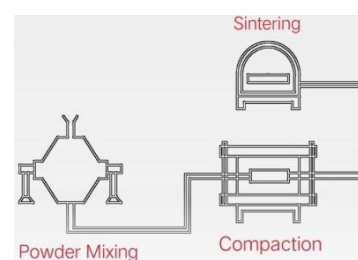


Fig. 1: Process flow of the powder metallurgy process