STUDY OF WEAR ON ANODISED PM ALUMINIUM MATRIX COMPOSITE REINFORCED WITH 15 wt % SAFFIL™ ALUMINA SHORT FIBRE

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A study of wear behaviour on anodised powder metallurgy aluminium matrix composites (PM AMC) reinforced with Saffil™ alumina short fibres was done. AMC was fabricated by powder metallurgy methods (PM) with using Al flake powders and Saffil™ alumina short fibres. PM AMC reinforced with 15 wt% Saffil™ alumina short fibre was selected because it showed optimum mechanical and physical properties. Sulphuric acid anodising process was carried out with 15% concentration of sulphuric acid concentrations, 18 V anodising voltage and 60 minutes anodising time at room temperature. Scanning electron microscope (SEM) was used to investigate coating morphology and thickness. The pin on disk test was used for wear testing with 1 kg load in 150 rpm rotating speed. This reserch was found that H_2SO_4 anodising was able to give good coating to MMC. The AMC showed lower wear rate compared to the Al samples. Anodising process will be reduced 59% and 13% wear coefficient of Al and AMC. The research was found that H_2SO_4 anodising was able to give good coating to AMC and give good wear resistance.

Keywords: Anodising, Powder metallurgy, wear, metal matrix composite, aluminium

1.0 Introduction

PM aluminium matrix composite (PM AMC) is a family of advanced materials which are growing fast and attract the whole world because of its properties. PM AMCs are one of the MMC which have many advantages over the conventional material. High performance metal that has low density is desirable for increasing the efficiency of fuel in the transportation system and decreasing the pollution of environment [1].

Anodising is used as the coating technique in this study. The specimen was connected at anodic or positive terminal in electrochemical cell. The cathode side is an inert and conductive material, which is graphite. Types of anodising depend on what solution to be used and electrical current applied. In industrial application, sulphuric acid is a major bath solution in anodising process. Another type of solution is chromic acid [2].

Wear is one of destruction phenomena always happen in metal materials. Wear are generated from friction action. Wear were involved the loss of material mass on solid surface affected by interaction two materials contacted. Another factor will influence d the wear were loading type, speed, temperature and lubricant [3]

The objective of this research is to study the wear behaviour on PM Al and PM AMC reinforced with 15 wt% short fibre alumina Saffil™

2.0 Experimentals

Aluminium matrix composite (AMC) was fabricated by powder metallurgy method. The AMC consists of two components. The flaky aluminium powder was mixed with 15 weight percentages of Al_2O_3 Saffil™ short fibre in a plastic container. Alumina balls with 15 mm average diameter were used as mixing media. These procedures based on previous studied that carried out by Baker et. al [1] and Hong & Kim [2]. All mixtures were compacted at 210 MPa by using a single action press. The compacted specimens were sintered at 610 °C for 7 hours with 10 °C/min heating rate in nitrogen gas.

Anodising process was the coating technique used in this study. Output voltage in this process was 18 V. Anodising process is done in 60 minutes at room temperature. The study anodising process was carried out with 15 % sulphuric acids concentration. Anodising process was performed using the aluminium matrix composite reinforced with 15 wt% short fibre alumina Saffil™ as anode an aluminium foil as cathode. The anodised specimen substrate was rinsed with water at room temperature and sealed with pure water in 80 °C for 30 minutes followed by drying.

Wear test was done on anodised and non-anodised PM AMC. The test carried out using pin-on-disk methods. The contacting materials using in this research are stainless steel. The testing allowed the ASTM G-99 standard [5]. The specimen in rod form with 10 mm diameter were using in the test. The wear testing performed in 5 minute continuous periods. The rotating disk speed was 150 rpm. 1 kg loading was applied on the surface. The wear rate was measure and their surface morphology was taken using Olympus BX51M.

3.0 Results and discussion

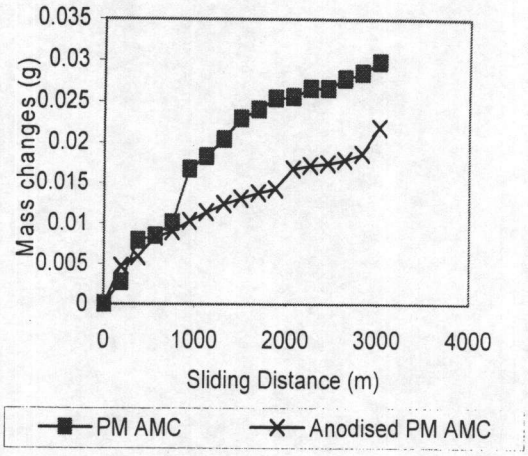

Figure 1: The mass loss versus sliding distance

Fig. 1 shows the mass loss versus sliding distance for anodised PM Al and PM AMC. The mass loss increased with increasing sliding distance. Both specimens have shown the same curve pattern as indicated in figure 1. These graph indicated two parts as knows severe wear and followed by mild wear. For PM Al indicate severe wear was happen at 377 m where the mass loss higher increased 0.06 g. After 377 m, the mild wear was happen with indicated uniformly changes of mass until it reach 0.11 g at 3000 m sliding distance. For PM AMC, the severe wear indicated before 845 m sliding distance meanwhile the mild wear happened after 945 m sliding distance. The mass loss increased linearly with sliding distance. The transition of severe wear to mild wear caused from the mass loss by friction force and pin-disk position magnitude [3].

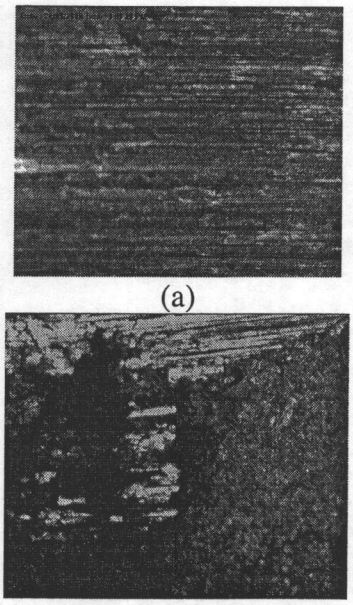

Figure 2: The surface morphology after wear testing (Magnification 50x).

Fig. 2 indicated the surface morphology after wear testing for anodised PM Al (Fig 2a) and anodised PM AMC (Fig 2b). Both figure shown the abrasive wear behaviour. However, the scratches of PM Al are clear and the more roughness compare to PM AMC. These phenomena is happen because the friction path at the PM Al easier to form compare the PM AMC which have 15 wt% short fibre alumina. The hardness of PM AMC higher compare to PM Al will be made the formation of scratch difficult for PM AMC rather than PM Al [4].

4.0 Conclusion

The wear behaviour of PM AMC and anodised PM AMC were investigated. The mass changes of PM AMC were smaller than PM Al. The PM Al showed the wide severe wear region in the graphs. The presence of short fibre as reinforcement will be decreased the severe wear region. The scratch at the surface also decreased at PM AMC rather than PM Al. This research found that PM AMC more wear resistance compared to PM Al.

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