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ORIGINAL PAPER

Microstructural and Tribological Properties of A356 Al–Si Alloy Reinforced with Al_2O_3 Particles

Aleksandar Vencl · Ilija Bobić · Milan T. Jovanović · Miroslav Babić · Slobodan Mitrović

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Abstract In the present study, the effect of the Al_2O_3 particles (average size of 12 μm, 3 and 10 wt.%) reinforcement on the microstructure and tribological properties of Al–Si alloy (A356) was investigated. Composites were produced by applying compocasting process. Tribological properties of unreinforced alloy and composites were studied, using pin-on-disc tribometer, under dry sliding conditions at different specific loads and sliding speed of 1 m/s. Microhardness measurements, optical microscope and scanning electron microscope were used for microstructural characterization and investigation of worn surfaces and wear debris. During compocasting of A356 alloy, a transformation from a typical dendritic primary α phase to a non-dendritic rosette-like structure occurred. Composites exhibited better wear resistance compared with unreinforced alloy. Presence of 3 wt.% Al_2O_3 particles in the composite material affected the wear resistance only at specific loads up to 1 MPa. The wear rate of composite with 10 wt.% Al_2O_3 particles was nearly two order of the magnitude lower than the wear rate of the matrix alloy. Dominant wear mechanism for all materials was adhesion, with others mechanisms: oxidation, abrasion and delamination as minor ones.

Keywords Compocasting · Al–Si alloy · Al_2O_3 particles · Dry sliding · Friction · Wear

1 Introduction

The use of different types of metal matrix composites (MMCs) is constantly growing because they possess better physical, mechanical and tribological properties compared to the matrix materials. Composite materials based on light metals like aluminium, magnesium and zinc find application in many industries due to their low density [1–5].

The idea that a relatively small amount of reinforcement can improve characteristics of matrix material is attractive, and constant improvements of MMCs technological processing and possibilities for their new applications are not a surprise. Numerous authors investigated friction and wear properties of aluminium matrix composites studying the influence of different parameters, such as:

- the type of the matrix and counter body material and their hardness [6–8],
- the type of the reinforcements, their shape, size and volume fraction [9–11] and
- testing conditions (load, speed, temperature, type of relative motion, lubrication and environment) [12–14].

Most of these investigations were conducted on model type pin-on-disc tribometers. A more detailed review of the apparatus, materials and testing conditions used can be found elsewhere [15, 16].

The results obtained from the applied load and reinforcement content effects on friction and wear properties of

A. Vencl (✉)
Tribology Laboratory, Mechanical Engineering Faculty, University of Belgrade, Kraljice Marije 16, 11120 Belgrade 35, Serbia
e-mail: avencl@mas.bg.ac.yu

I. Bobić · M. T. Jovanović
Department of Materials Science, Institute of Nuclear Sciences "Vinča", P.O. Box 522, 11001 Belgrade, Serbia

M. Babić · S. Mitrović
Tribology Laboratory, Mechanical Engineering Faculty, University of Kragujevac, Sestre Janjić 6, 34000 Kragujevac, Serbia