Tribol Lett (2010) 37:401–410
DOI 10.1007/s11249-009-9535-2

ORIGINAL PAPER

Tribological Behavior of Composites Based on ZA-27 Alloy Reinforced with Graphite Particles

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Received: 29 June 2009 / Accepted: 26 October 2009 / Published online: 7 November 2009

Abstract The objective of this investigation is to assess the influence of graphite reinforcement on tribological behavior of ZA-27 alloy. The composite with 2 wt% of graphite particles was produced by the compocasting procedure. Tribological properties of unreinforced alloy and composite were studied, using block-on-disk tribometer, under dry and lubricated sliding conditions at different specific loads and sliding speeds. The worn surfaces of the samples were examined by the scanning electron microscopy (SEM). The obtained results revealed that ZA-27/graphite composite specimens exhibited significantly lower wear rate and coefficient of friction than the matrix alloy specimens in all the combinations of applied loads (F_n) and sliding speeds (v) in dry and lubricated tests. The positive tribological effects of graphite reinforcement of ZA-27 in dry sliding tests were provided by the tribo-induced graphite film on the contact surface of composite. In test conditions, characterized by the small graphite content and modest sliding speeds and applied loads, nonuniform tribo-induced graphite films were formed leading to the increase of the friction coefficient and wear rate, with increase of the sliding speed and applied load. In conditions of lubricated sliding, the very fine graphite particles formed in the contact interface mix with the lubricating oil forming the emulsion with improved tribological characteristics. Smeared graphite decreased the negative influence of F_n on tribological response of composites, what is manifested by the mild regime of the boundary lubrication, as well as by realization of the mixed lubrication at lower values of the v/F_n ratio, with respect to the matrix alloy.

Keywords ZA-27 alloy · Graphite particles · Composites · Tribological behavior

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1 Introduction

Due to wide potential applications, composite technology has been developed very intensively over the recent decades [1]. Metal matrix composites (MMCs) have emerged as an important class of advanced materials giving engineers the opportunity to tailor the material properties according to their needs [2]. Discontinuously reinforced metal composites were developed during the 1980s with attention focused on Al-based matrices reinforced with SiC particles, or Al_2O_3 particles or short fibers. A combination of good properties, low cost and high workability has made them attractive for many applications [3].

Zinc–aluminum (ZA) alloys are important bearing materials, especially suitable for high-load and low-speed applications [4]. Due to good tribo-mechanical properties, low weight, excellent foundry castability and fluidity, good machining properties, low initial cost, and environmental-friendly technology, the ZA alloys (mostly ZA-12 and ZA-27) are capable of replacing aluminum cast alloys and bearing bronzes, as well as the cast iron, plastics, or even steels for manufacturing the triboelements for operation under conditions of moderate exploitation temperatures. These characteristics have inspired researchers to reinforce them with different dispersed reinforcement materials (short fibers, or particles) to obtain much more enhanced