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Effect of load on friction and wear behaviors of alumina matrix ceramic guideway materials

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Abstract

According to the tensile crack model, a simple model for tribological behaviors of diopside/AlTiB toughened alumina matrix ceramic guideway materials, predicting the relationship between load and wear rate, was presented. 45[#] steel ring was used as the counterpart. Mechanical properties and wear properties of the guideway materials under different loads were investigated. SEM micrographs of wear tracks on typical specimens were studied. Results showed that the experimental data described in this paper were in accordance with the theoretical prediction. Introduction of diopside and AlTiB master alloys in alumina matrix ceramic guideway materials improved their mechanical properties, friction and wear properties. The wear rate of pure alumina was in the order of $10^{-15} \text{m}^3/\text{N}\cdot\text{m}$ while that of guideway materials toughened by diopside and AlTiB master alloys was in the order of $10^{-16} \text{m}^3/\text{N}\cdot\text{m}$. The wear mechanisms of pure alumina may be brittle fracture and grain pull-out. The dominant wear mechanisms of alumina matrix ceramic guideway materials toughened by diopside and AlTiB master alloys may be mechanical interlocking and plastic deformation combined with a little micro-fracture and grain pull-out.

Key words: Alumina; Ceramics guideway; Friction and wear; Wear mechanism

1. Introduction

Major challenges in advanced structural ceramics such as manufacture reproducible, long lifetime, self-lubricating is proposed in mechanical systems that involve high loads, velocities and temperatures. Due to their virtues of low weight, high stiffness, corrosion resistance, wear resistance, low coefficient of thermal expansion and friction coefficient, advanced alumina matrix ceramic materials offer a great potential in the fields of fine measuring implement, fine sliding way, working platform and high-speed bearing, etc., where high precision durability and long working life are required. However, processing and

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