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Repeatability of friction and wear of different material pairs at 1000 °C under unidirectional sliding motion

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There is no agreement to date on how to evaluate tribological results at high temperatures. In this study, six tribopairs, i.e. a combination of three spheres (upper specimens) and two disks (lower specimens), were tested under unidirectional sliding motion at 1000 °C. The friction and wear results obtained were analyzed to select a tribopair as the most suitable high temperature reference material.

Keywords (from 3 to 5 max): high temperature, sapphire, silicon nitride, Inconel, reference material

1. Introduction

High temperature tribology (>600 °C) influences operations in metals, energy, mining and transformation industries. Tribometers are used to study the impact of different factors on the friction and wear at high temperature. Temperatures up to 1000 °C pose a significant challenge in terms of stress on the test instruments and stability of the tests results. Thus, the repeatability and reproducibility of test results are difficult to achieve. There is no agreement to date to assess the quality of data generated at high temperature and how the repeatability of such harsh tests should be determined. In this study we analyzed the friction and wear behavior of six tribopairs at high temperature, considered as possible reference material for high temperature tribology.

2. Methods

The samples used were in the form of balls (silicon nitride, sapphire, alumina) and disks (Inconel 725, gas pressured sintered silicon nitride). The tests were conducted in a unidirectional sliding motion (rotation), under a 5 N load, both at ambient temperature and 1000 °C.

3. Discussion

At ambient temperature, friction followed an increasing trend for all tribopairs, whereas at 1000 °C the increase in friction over the test time was minimal. In the case of alumina ball on IN 725 disk, the wear on the ball increased at high temperature; in all the other cases, the wear on the ball was lower at 1000 °C. The repeatability of friction and wear results varied with the test temperature: at room temperature, friction showed greater repeatability than wear (average coefficient of variation of 15.77% and 38.97%, respectively); at 1000 °C, the average coefficient of variation for friction decreased to 8.66%, but the wear results were more scattered, with an average coefficient of variation of 109.54%.