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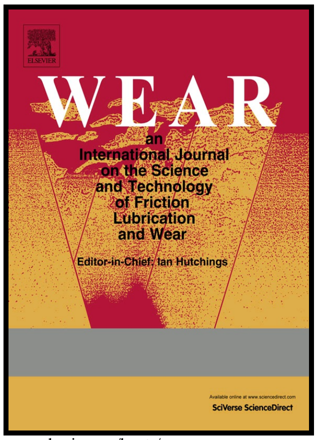

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Abstract

Wear of materials at high temperatures (HT) is a very challenging issue, implying many different mechanisms. Individual wear phenomena occurring during abrasive contact at HT can be investigated by scratch testing. To study the influence of temperature and load on scratch behaviour a novel scratch test was utilised, allowing for scratch investigations up to 1000°C. Three materials for HT usage were chosen for investigation: an austenitic steel, a cast steel with carbide network and a Ni-based material with carbide network. Test load was varied from 10-100 N and temperature steps were room temperature, 500°C and 800°C. Additionally hot hardness tests were performed to measure the hardness-temperature dependency of the materials.

The three materials show very diverging wear behaviour at the investigated temperatures. While at low temperatures the wear scars are relatively smooth, wear behaviour became instable with temperature induced material softening. Especially inhomogeneous materials show pronounced stick-slip phenomena at highest testing temperatures. To understand the wear behaviour in a greater detail, numerical simulations of the scratch process were undertaken using smooth particle hydrodynamics. First results show a good correlation with wear scars of the austenite and allow a deep insight in the stress distribution and deformation process during scratching.

Keywords: Abrasion, high temperature, scratch test, smooth particle hydrodynamics.

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1. INTRODUCTION

Wear at high temperature (HT) is of major concern in industry, as many applications operate at elevated temperatures. Hence the knowledge of wear resistance of applied alloys is of great interest. The simulation of abrasive wear phenomena by scratch testing is an adequate solution for addressing single interactions with abrasive particles. Thereby wear mechanisms such as material deformation, work hardening, micro-cutting, etc. can be studied at a fundamental level [1].

Scratching is done by a hard indenter, like Rockwell or Vickers diamond tips. Nevertheless, scratch tests for elevated temperature investigation are scarce [2,3]. A novel scratch tests, also utilised for this work, was introduced by Varga et. al in [4] allowing for testing up to 1000°C. Post-test analysis of the scratch can give useful information on the present wear mechanisms. Topography measurements