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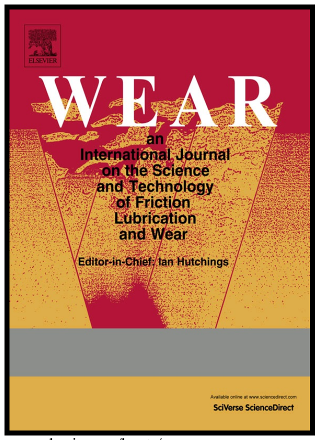

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Temperature and load influence on in-situ formed layers during high temperature abrasion

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Abstract

Abrasive wear at high temperature (HT) applications is a serious issue in industry, limiting the lifetime of core components, e.g. in steel- or cement production. In literature abrasive wear is commonly linked to material's hardness, but it is known that microstructure and temperature show also major influence. Current studies also found wear protecting effects by the in-situ formation of mechanically mixed layers (MML) with the abrasive, which can be especially beneficial at HT.

To investigate the temperature and load influence of this MML formation at high-stress abrasive conditions a modified ASTM G65 test, allowing for temperatures up to 700°C, was utilised. Two metal matrix composite (MMC) materials prone to MML formation were chosen: a Ni-based and Fe-based cast alloy with carbide content of ~15 %. Thereby the MMC matrix influence on MML formation was studied. Load was varied from 10 to 45 and 80 N, and temperature from room temperature to 500°C and 700°C. Abrasive is collected during tests in order to determine the severity of the contact during the wear process. Post-test analysis investigate the MML coverage and depth in order to estimate the wear protecting effect. Further micro-hardness investigations and nano-scratch experiments should identify fundamental wear mechanisms and load bearing capacity of the hard phase network.

It was found that increasing load leads to higher severity of the contact (more abrasive breakage). MML coverage was strongly dependent on load and temperature at the Fe-based material. Despite a pronounced drop of the hardness at 500°C this material features efficient wear protection by MML formation at HT. On the other hand the Ni-based MMC shows minor temperature and load influence on MML formation, which can be put down to its relative temperature stable fcc matrix. Wear rates of the Ni-based MMC are superior to the Fe-based material at highest testing temperature. Strain hardening and dynamic recrystallisation were found to be beneficial especially at 500°C for the Ni-based MMC.

Keywords: High temperature, abrasion, high-stress, MMC, nano-scratch, mechanically mixed layer.

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