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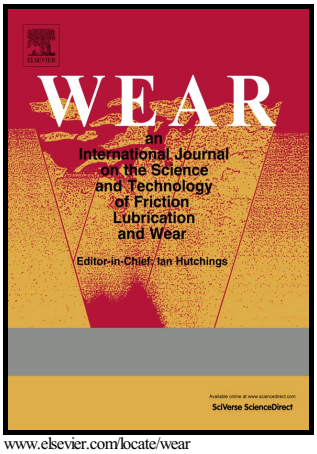

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Tribological properties of AZ31 alloy pre-deformed at low and high strain rates via the work function

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Abstract

Hardness, tribological properties and electron work function (EWF) of AZ31 alloy pre-deformed at high and low strain rates were investigated. It was observed that the pre-deformation lowered hardness of the magnesium alloy, ascribed to the formation of micro-cracks/voids in addition to dislocations. The deformation at the higher strain rate resulted in larger decrease in hardness and consequently more material loss during wear tests. XRD diffraction analysis did not provide clear clues in regard to residual strain that is related to the dislocation density. However, the observed influences of the strain rate–dependent pre-deformation on the properties of the alloy are explainable based on corresponding changes in work function. It was observed that the lower strain rate led to a larger decrease in EWF, corresponding to a higher fraction ratio of dislocations to micro-cracks/voids, which affected the performance of the alloy. First-principle calculations were conducted to investigate changes in EWF caused by dislocation and vacancy cluster, respectively, which support the explanation. This study demonstrates that the work function can provide supplementary information towards clarification of underlying mechanisms for the observed phenomena.

Keywords: Cold-work, Strain rate, Work function, Wear, Corrosive wear