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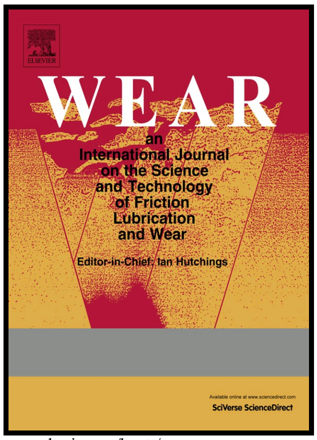

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Tool microstructure impact on the wear behavior of ferrite iron during nanoscratching: an atomic level simulation

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Abstract

In the present work, molecular dynamics simulations were used to investigate the impact of the tool microstructure on the wear behavior of ferrite workpiece during nanoscratching. The tool microstructure was modified by varying the carbide (cementite) contents. The simulation results show that dislocations are the primary mechanism for plastic deformation of the workpiece material. It is found that total dislocation length varies significantly depending on the carbide content in the tool. Furthermore, other tribological phenomena were also observed to depend on the carbide contents. For example, the average value of frictional forces decreased while the normal force increases with increasing carbide contents, and hence the friction coefficient was decreased. Additionally, the shape and size of lateral and frontal pileups are lowered. The structural analysis of the pileup region reveals the loss of long range order and start of amorphisation. The temperature distribution of the pileup regions showed an increase of the pileup temperature when carbide is added into tool. The wear volume is considerably reduced when the carbide content increases. The average scratch hardness was found to decrease and the result was analyzed with the theoretical Taylor hardening model.

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Keywords: *molecular dynamics, carbide, wear volume, dislocation, pileup.*

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