Deformation dependent nano-friction and wear properties of different fcc metals

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Sliding and scratching are fundamental tribological phenomena which affect surface-near zones of materials. To clarify ongoing tribological and microstructural mechanisms, a thorough analysis of various phases present in different metals was performed via nano-scratching and sliding at different load situations. Nano-indentation was used to evaluate the phases' mechanical properties such as hardness H, Young's modulus E and the ratios H/E and H^3/E^2, which influence abrasive wear and the yield strain.

Aluminum, austenitic steel and copper were chosen to evaluate the change of wear mechanisms and COF at different load levels. EBSD measurements at the respective scratch surfaces provide deeper insight on the degree of deformation and deformation induced phase changes.

Results show an influence of the materials hardness, the Young's modulus and the ratios H/E and H^3/E^2, and eventual phase changes on the deformation and wear mechanisms and moreover the COF. If deformation is present, the geometrical effect of the indentation depth on the COF becomes dominant, while at sliding conditions other effects are more important. Mechanical properties tend to be a key factor for a changing wear mechanism from ploughing to chipping, which was identified at all metallic materials investigated.

Keywords: Sliding behavior, Scratch testing, Scanning Electron Microscopy, Electron Backscatter Diffraction, Wear mechanisms, Tribo-indentation

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