Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Atomic Origins of Friction Reduction in Metal Alloys

MICHAEL CHANDROSS, SHENGFENG CHENG, Sandia National Laboratories — Gold is a desirable material for use in high performance electrical contacts because it offers low contact resistance, does not corrode or oxidize, and can be easily made into thin sheets. However, gold contacts generally suffer from high adhesion and friction. The tribological issues are mitigated in nanocrystalline gold alloys (with, for example, Ni or Co), which can exhibit both low friction and low contact resistance. The atomic scale mechanisms responsible for the change in frictional response are poorly understood. We will present the results of large scale molecular dynamics simulations which study the tribological response of nanocrystalline films of pure gold and alloys under a variety of sliding conditions. Our results indicate that in pure metals, cold welding and microstructural reorientation lead to the formation of a commensurate sliding interface and high friction resulting from dislocation controlled plasticity. In alloys, however, differing lattice constants suppress the reorientation of grains at the contact point, which leads to grain boundary sliding and lower friction.

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Date submitted: 11 Nov 2011 Electronic form version 1.4