

**Invited Talk Abstract for 20<sup>th</sup> International Colloquium on Tribology - Stuttgart, Germany**

Title: *Why IS there a correlation between hardness, friction and wear of metal contacts? Modifying microstructural mechanistic misconceptions*

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**Abstract**

The extraordinary mechanical properties of nanocrystalline metals are well documented, though in many ways these materials remain impractical for engineering design. The transition from grain boundary to defect dominated plasticity associated with grain coarsening can be brought about rapidly by the addition of even modest amounts of stress or heat, dramatically reducing the strength of nanocrystalline metals and adversely impacting tribological behavior. While it is possible to achieve low friction and ultra-low wear with metal contacts, the ability to quantify and predict stability bounds remains elusive, leaving engineers with only phenomenological models as design tools. We show new and compelling fundamental correlations between experimental and MD simulation data, and present a physics-based predictive framework describing the tribological stability thresholds of nanocrystalline metallic contacts. In the context of this “tribological stability framework” we also address the long-standing misconception that higher hardness leads to higher wear resistance, explain the origin and regimes of validity of this notion, and provide a more reliable and quantitative alternative mechanistic model.

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