Functional Multilayer Coatings,

Simultaneous Experimental and Modeling Approach seeking Ultra-durability

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A novel concept of hierarchical surface protection has been proposed to protect harsh condition exposed surfaces. The aim is to design and fabricate a protective, industrial compatible and cost effective coating in nano-scale to increase the lifetime and durability of the surfaces exposed to constant and dynamic sliding contacts in micro-electronic devices. This concept seeks combining advantages of superior properties of single-layer metal/DLC and ceramic coatings, without compromising on weaknesses of them. Functional Multilayer Coatings (FMCs) of WC/DLC by tailoring the material gradient through the “Layer-Architecting” has been synthesized and examined.

The main objective of this research is to understand and predict the deformation and failure mechanisms in metal/carbon-ceramic multilayer coatings across scale, as exposed to sliding contacts in medium to high contact pressures ranging from hundreds of MPa to several GPa. The indentation creep and scratch behavior of the aforementioned multilayer design has been studied fundamentally throughout Molecular Dynamic (MD) simulation and exclusive experimental set-ups.

The results of the numerical calculations and the experimental investigations of the functional multilayer coatings revealed that creation of multiple concept-based, interfaces, and intermixing of layers, play a crucial role in the excellent durability and superior mechanical properties of the FMCs.

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