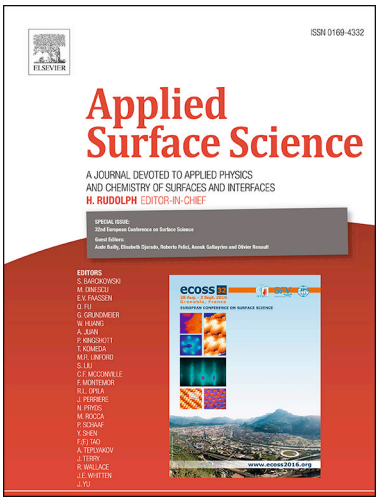

Full Length Article

TiMoN nano-grains embedded into thin MoS_x -based amorphous matrix: A novel structure for superhardness and ultra-low wear

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TiMoN nano-grains embedded into thin MoS_x-based amorphous matrix: A novel structure for superhardness and ultra-low wear

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Abstract

Molybdenum disulfide (MoS_2) represents a highly sought lubricant for reducing friction based on intrinsic layered structure, unfortunately, practical applications have been greatly restricted due to the fact that its low hardness would cause severe wear. Here, a novel TiMoN/a-MoS_x composite coatings with TiMoN solid solution grains embedded into MoS_x-based amorphous matrix has been successfully designed and synthesized, through magnetron co-sputtering technology. Desirably, in virtue of such special microstructure, superhardness and excellent toughness can be well achieved, along with an ultra-low wear rate at ~2×10^{-11} mm^3/Nm in air. Simultaneously, a low friction at ~0.1 is maintained. It should be noted that this wear level is almost two orders of magnitude lower than that of pure TiN coating, and is, as we known, the lowest wear rate in dry sliding. Investigations of tribofilm reveal that it is amorphous MoS_x in nature, and its formation arises directly from the transfer of MoS_x amorphous matrix to frictional interface. Which contributes to effective lubrication behavior, coupled with excellent mechanical performances of such composite coating, exceptionally low wear can be guaranteed. The designed special structure makes it possible for the synthesis of super-hard and super-durable lubricative coating for industrial application.

Keywords: MoS_2; Composite coatings; Hardness; Toughness; Friction; Wear.