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Annealing effect on the fracture toughness of CrN/TiN superlattices

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Abstract

Superlattice films are generally known for their exceptional high hardness compared to their monolithic constituents. Recently, we have shown that CrN/TiN superlattice films exhibit a peak in fracture toughness for a bilayer period of 6.0 nm, similar to the former reported peak in hardness. We propose that a dominating factor for obtaining such favourable material properties is the interface constitution between the individual layers.

To proof this notion, we have intentionally modified the interface sharpness by post-deposition vacuum annealing of the samples at different temperatures. This promotes interdiffusion of Ti or Cr into its adjacent layers and gradually changes the interfaces to interphases (because TiN and CrN form a solid solution). In order to obtain reliable K_{IC} fracture toughness values as a function of the annealing temperature, in-situ micromechanical cantilever bending tests on *ex-situ* vacuum annealed freestanding films were performed. High temperature loads take also place during machining processes like dry cutting or high-speed cutting, and are thus of high practical relevance.

Keywords

Hard coatings, Superlattice, Fracture toughness, Micromechanical testing, Annealing effect