ANNEALING EFFECT ON THE FRACTURE TOUGHNESS OF CrN/TiN SUPERLATTICE SYSTEMS

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Coherently grown nanolayered thin films are generally known for their superior mechanical properties, compared to their monolithically grown constituents. Recently, we have shown that CrN/TiN superlattice films exhibit a bilayer period dependent peak in fracture toughness K_{IC}. We propose that a dominating factor influencing these mechanical properties is the interface constitution between the layers.

To proof this concept we modified the interfaces of CrN/TiN superlattice thin films with a bilayer period Λ of 9 and 18 nm by vacuum annealing experiments at different temperatures. This treatment promotes interdiffusion between CrN and TiN layers, leading to the formation of “blurred” interfaces and further on to interphases (CrN and TiN form a solid solution), as well as the reduction of coherency strains in the interface region.

To calculate the fracture toughness of our hard coatings, we performed *in-situ* micromechanical cantilever bending tests on the *ex-situ* vacuum annealed samples. As expected for coatings without an age hardening effect, the hardness *H* decreases with increasing annealing temperature for both superlattice systems. For $\Lambda = 9$ nm the fracture toughness experiences a similar reduction following predictions given by the empirical *H*/*E* criteria. However, the coating with $\Lambda = 18$ nm does not follow this criteria and exhibits a peak in fracture toughness for an annealing temperature of $T_a = 700$ °C.