Crystallographic texture development during magnetron sputtering of (Ti,Al)N.

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Abstract

(Ti,Al)N nitride coatings obtained by Physical Vapor Deposition (PVD) have received a growing interest as hydrogen permeation barrier (HPB). The magnetron sputtering process allows tailoring the morphological and topological aspects of coatings, as well as their crystallographic textures. These aspects are affected by the energy of the sputtered atoms and by the growing conditions of coatings, that depend on the experimental processing parameters. In addition, the nature of the substrate, as well as the orientation of the adatoms flux with respect to the substrate surface, influence the crystallographic texture built up during processing.

In this context, (Ti,Al)N coatings were grown by co-sputtering using two PVD magnetron sputtering devices with distinct sample rotation configurations. Three different substrates were tested, i.e. amorphous glass, Si single crystal and a polycrystalline ferritic steel. (Ti,Al)N was deposited either directly on the substrate or on a thin intermediate Ti film. The crystallographic texture of the coatings was analyzed by X-Ray diffraction and by Transmission Kikuchi Diffraction. Additionally, surface and cross-section microstructures were observed by high resolution Scanning Electron Microscopy.

A large variety of textures, ranging from nearly isotropic towards very sharp ones, were obtained depending on the processing conditions of the process, the substrate and the coating thickness. They reflect clearly the symmetry of the process with a circular symmetry in one case and a mirror plane in the other case. The influence of the substrate, although indirect because of the presence of a very thin Ti adhesion layer in most of the samples, is clearly evidenced. The 'texturization' with increasing thickness and a progressive predominance of the $< 111 >$ directions parallel to the normal of the specimens is well explained by a selective growth mechanism. The presentation will analyze and explain the coating textures in relation with the various processing parameters.

Keywords: PVD, magnetron sputtering, crystallographic texture, (Ti, Al)N coatings

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