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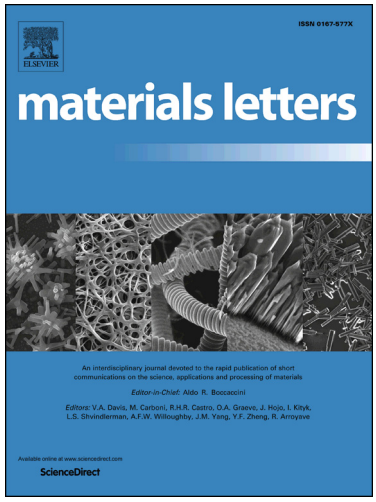

Interrelationships among macrostress, microstructure and mechanical behavior of sputtered hard Ti(Al,V)N films

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Interrelationships among macrostress, microstructure and mechanical behavior of sputtered hard Ti(Al,V)N films

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Abstract

The article reports on the influence of a compressive macrostress σ in the Ti(Al,V)N films on their mechanical properties, structure, microstructure, and resistance to cracking. The macrostress σ is controlled by the energy $\mathcal{E}_{bi}$ delivered into the growing film by bombarding ions. The Ti(Al,V)N films were sputtered by a dual magnetron with closed magnetic field. It is shown that (1) the compressive macrostress ($\sigma < 0$) increases the hardness H of the film and the ratio H/E^*, (2) the films exhibits a dense, voids-free, non-columnar microstructure in the case when the energy $\mathcal{E}_{bi} \geq 3$ MJ/cm^3, (3) the enhanced resistance to cracking of the films is controlled by its mechanical properties, microstructure and macrostress σ; here E^* is the effective Young's modulus.

Keywords: Ti(Al,V)N films, Hardness, Macrostress, Energy, Microstructure, Structure, Mechanical properties, Resistance to cracking

1. Introduction

A macrostress σ generated in the film prepared by an ion plating sputtering strongly influences its hardness H and structure and thereby its physical and functional properties. The stabilization of the β-Ta [1] or the c-Zr_3N_4 phase in the film [2], the superconductivity of film [3], the Curie temperature of film [4], a change of the preferred orientation of film [5-7], and the lifetime of the cutting tools coated by protective hard coatings [8-10] can be given as examples. However, so far, there is little information about the influence of σ on the hardness H of film and its resistance to cracking [11-13].

2. Experimental