Microstructure of Thin (V,Al)(C,N) Hard Coatings

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Hard coating materials are used as protection layers to increase the lifetime of various devices. A new type of hard coating materials are (V,Al)(C,N) nanocomposite. They are expected to have better properties than commercially used (Ti,Al)N. Thermodynamic calculations indicate that the quarternary (V,Al)(C,N) system has a lower interaction energy than TiAlN [1], which enhance the solubility limit of AlN into the fcc lattice. However, not only the material system, but also the crystalline phase and the microstructure influence the hardness. It is reported that fcc-TiAlN shows a higher hardness than coating with mixed hcp and fcc TiAlN [2]. A similar behaviour is also expected for (V,Al)(C,N).

A series of thin (V,Al)(C,N) coatings was deposited by rf magnetron sputtering. Six individual substrates were placed in a row and then coated simultaneously, resulting in coatings with different thickness and chemical composition.

We have performed X-ray diffraction experiments in order to investigate the microstructure of the coatings. The crystalline phase, the texture and the residual stress were analyzed. All coating reflections measured in specular geometry are attributed to the fcc phase. No hcp phase is observed. The reciprocal space map and the pole figure (see Figure 1) measurements indicate that all samples are [111] textured. However, the preferential orientation with respect to surface normal varies from one sample to the others. Strain maps show that all coatings are laterally compressed. The residual stress is estimated by the $\sin^2\psi$ method.

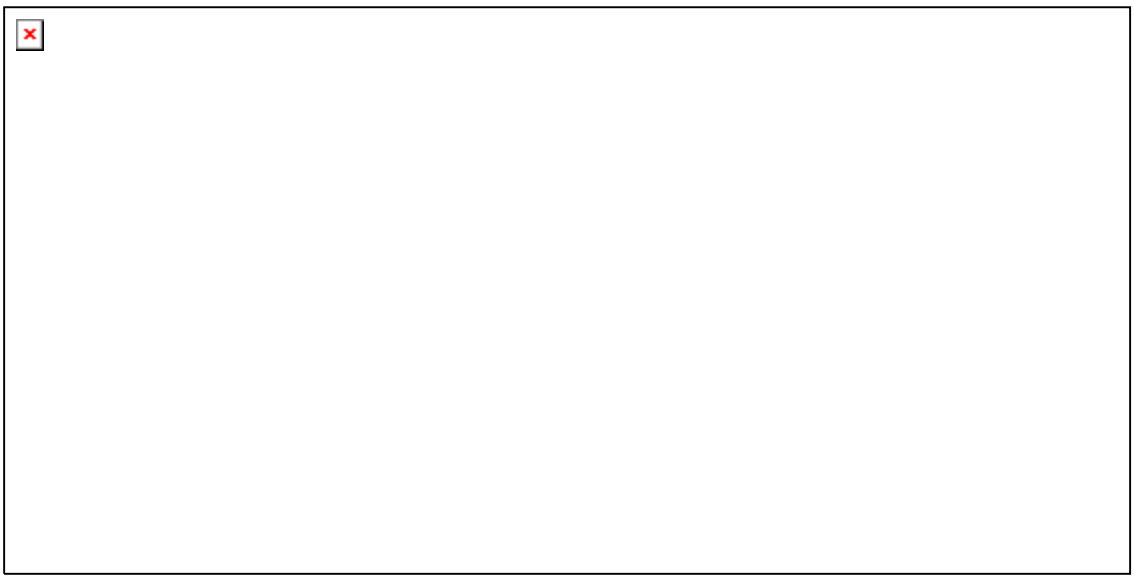

Figure 1.A) (111) Pole Figure B) . d_{111}-$\sin^2\psi$ graph

[1] C.Ziebert et al, Plasma Prosess and Polymers, 2009, S560 – S565
[2] R.F. Zhang et al., Materials Science and Engineering A 448, 2007, 111-119