Preparation and characterization of the sputtered TiAlN coatings using a Ti-Al alloy metal target

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Titanium aluminium nitride (TiAlN) ternary coatings were deposited on glass substrates by means of reactive magnetron sputtering technique, using a Ti-Al alloy metal target (Ti0.5Al0.5). The depositions were performed at various N2 and Ar flux ratios of N2/(Ar+N2)= 33, 50, 67, 83%. The structure, morphology, chemical composition and mechanical properties were investigated by X-ray diffraction (XRD), field emission scanning electron microscope (FE-SEM), energy dispersive X-ray spectroscopy (EDS), and nano-indenter (MTS System), respectively. The orientation of coatings depends on the flux ratios of N2/(Ar+N2) and substrate temperature. The coatings deposited with N2/(Ar+N2) ratios of 33, 50 at.% consists of pyramid-like column grains separated by porous and voids, which can be attributed to cubic-TiN (220) preferred orientation. The coatings deposited with N2/(Ar+N2) greater than 67% exhibits the phase of hexagonal-AlN and cubic-TiN. The surface of coatings becomes more compact and smoother with the N2/(Ar+N2) ratios increase. The coatings deposited with N2/(Ar+N2) ratio of 83% shows the largest hardness of 21.5GPa, which is attributed to the preferred (200) orientation. However, this hardness increases significantly with increasing substrate temperature.

The coatings deposited at more than 100? exhibited the (111) and /or (200) orientation. The amounts of grains grown along the (111) and (200) orientations play a significant role on the mechanical performance of TiAlN coatings. Four independent mechanisms, such as TiAlN stoichiometry and lattice parameter, the (111) preferred growth orientation, and the density increases (elimination of void), were found to contribute to the enhancement of TiAlN mechanical performance.

This research was financially supported by the Ministry of Education (MOE) and National Research Foundation of Korea(NRF) through the Human Resource Training Project for Regional Innovation (No. 2015H1C1A1035619) and This paper is a research carried out with the support of convergence technology development project by the Small and Medium Business Administration in the second half of 2016 (No. S2448757)