PREPARATION AND CHARACTERIZATION OF THE SPUTTERED TIALN COATINGS USING A TI-ALALLOY METAL TARGET

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Abstract - 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 ($Ti_{0.5}Al_{0.5}$). The depositions were performed at various N_2 and Ar flux ratios of $N_2/(Ar+N_2)$= 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 $N_2/(Ar+N_2)$ and substrate temperature. The coatings deposited with $N_2/(Ar+N_2)$ 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 $N_2/(Ar+N_2)$ greater than 67% exhibits the phase of hexagonal-AlN and cubic-TiN. The surface of coatings becomes more compact and smoother with the $N_2/(Ar+N_2)$ ratios increase. The coatings deposited with $N_2/(Ar+N_2)$ 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°C 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 increase (elimination of void), were found to contribute to the enhancement of TiAlN mechanical performance.