Study of structure development of Titanium Nitride coatings on inclined substrates

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For magnetron sputter deposited coatings, the structure development during growth mostly depend on the mobility of the adatom over the substrate, which is significantly affected by the orientation of the substrate with respect to the direction of the incident flux. In the present investigation, the effect of incident angle on the various aspects of the structure development of TiN coatings, deposited by reactive magnetron sputter deposition is studied. A 75 mm planar magnetron is used to sputter titanium in a mixture of argon and nitrogen gas. Si-wafers of size 1 cm x 1 cm are chosen as substrates. They are mounted on holders which can align them in different inclinations (0 to 90 degrees) with respect to the usual substrate plane (parallel to the target plane). The mounted substrates are aligned below the race track circle (identified by the erosion profile of the target) symmetrically below the target such that each of them receive equal sputtered flux. At an operating pressure of $3 \times 10^{-3}$ mbar, the magnetron is biased to the desired voltage to maintain a constant discharge current of 800 mA. The deposition is done for different durations. The deposited coatings are characterised using scanning electron microscopy and x-ray diffraction. Cross-sectional micrographs show the thickness and structure of the coatings. XRD gives information about the grain size, microstrain and the preferred orientation of crystallographic planes in the coatings. Results indicate the formation of well defined columnar microstructure in the coatings. It is observed that the length of the column, the inclination with the substrate plane, etc., depends on the angle of inclination of the substrate. Also a threshold exists for the formation of inclined columnar structures. That is, the columns grow normal to the substrate till the substrate tilt exceeds a certain value. Details showing the dependence of grain size and other structural properties will be presented.

Keywords
Magnetron
Sputter
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Column
Grain