Stress measurement and mechanical testing of titanium nitride films with graded residual stresses.

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Thin film residual stresses are known to affect the mechanical behavior of coated systems. Compressive stresses tend to improve wear resistance, as long as film/substrate adhesion is not impaired. Theoretically, thin film architectures with good tribological properties may be obtained if film deposition starts with lower stresses close to the interface (to improve adhesion) and if the compressive value is increased towards the surface (to reduce wear). This work describes the deposition of three architectures of titanium nitride (TiN) thin films: (i) one with increasing film stress, in which substrate bias voltage was graded from –20 V at the beginning of the deposition to –100 V at the end; (ii) one with decreasing stresses, in which bias was graded from – 100 V to –20 V and (iii) one where bias was kept constant at –40 V. This work also presents some techniques that were used to evaluate these systems. These techniques, both numerical and experimental, included stress measurement through X-ray diffraction or instrumented indentation, as well as mechanical testing through traction and unidirectional sliding against steel pins at two contact pressure levels.

Keywords: Thin films, residual stresses, X-ray diffraction, instrumented indentation, tensile testing, sliding tests

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