

Residual stress mapping in TiN coatings by nanoindentation technique

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Abstract

Titanium nitride (TiN) coatings were deposited on American Iron and Steel Institute (AISI) 410 stainless steel substrates by the cathodic arc physical vapor deposition process, varying the substrate bias voltage from 0 to 300 V. The residual stress in TiN coatings was measured using two different nondestructive testing techniques: grazing incidence X-ray diffraction (GIXRD) and nanoindentation. Classic GIXRD is used to determine the nature of residual stress. According to the macro-residual stress results, the continuous nanoindentation technique was used to estimate the residual stress distribution along the surface with accuracy in the nanometer range. The compressive stress was observed by the shift in load-depth curves. A previously developed methodology was used to map the residual stress at different nano-penetration depths. The presence of stress gradients was explained based on the mechanisms of stress generation. Keywords: TiN coatings, macro-residual stress, X-ray diffraction, nanoindentation, residual stress-depth profiling.