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The Use of Diffraction to Determine the Residual Stress of HVOF WC-17Co Coatings

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The investigation was conducted to determine the residual stresses of thermally sprayed HVOF WC-17Co coatings on different alloy substrates by non-destructive techniques. Non-destructive determination of residual stresses in the WC-Co coated systems was exceptionally challenging because coatings were only about 200 microns thick. The best-suited techniques for investigation of the WC coatings were diffraction-based strain scanning, using penetrating radiation such as thermal neutrons (most penetrating), high energy synchrotron X-rays (100 keV enables 20 micron penetration) and laboratory X-rays (limited to 5 micron penetration). Laboratory X-rays (Necsa, using Co radiation), thermal neutrons (ANSTO, Australia) and X-ray synchrotron (ESRF, France) were successfully employed to resolve the stress conditions. The influence of heat treatment was assessed by understated stress relief heat treatment of the grit-blasted substrates and coated substrates. The surface stresses of the coatings exhibited both small compressive and low tensile stresses on the as-sprayed coated samples. After annealing, the stresses became substantially more compressive. The near-surface trends of the grit-blasted substrates were completely relaxed after annealing, with thermal stresses being the dominant mechanism for residual stress induced due to the large difference in the coefficients of thermal expansion (CTE) between the WC coatings and the substrates.

References:

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