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High temperature structure, oxidation and tribological properties of TiAlCrN coatings

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There is an increasing number of applications for hard coatings in engineering where both high oxidation resistance and hot hardness are required. Titanium and Chromium aluminium nitride coatings produced by PVD and CVD techniques are routinely deposited on tools and tested as components for machining and forming applications. However, the behaviour of quaternary nitrides combining Cr, Ti and Al could outperform that of ternary nitrides, particularly at high temperatures.

In this study, we analyzed high temperature tribological behavior of TiAlCrN coatings prepared on WC substrates by low cathodic arc deposition. The coatings chemical composition was measured by Electron probe microanalysis (EPMA). The mechanical properties of these coatings were studied by scratch and microhardness testing. The morphology of the coatings surface, ball scars, wear tracks and wear debris were examined by scanning electron microscopy (SEM). The structure and oxidation were analyzed using high temperature X-ray diffraction (XRD) and Thermal Gravimetric Analysis (TGA), respectively, up to 1300 °C. Wear testing was carried out using a high temperature tribometer (pin-on-disc) with alumina counterparts. The evaluation of the friction coefficient with the number of cycles (sliding distance) was assessed at different temperatures and the wear rates of the coatings and balls were determined; the maximum testing temperature was 800 °C. Al₂O₃ balls with a diameter of 6 mm were used as counter-parts.

Keywords

nitride
high temperature
tribology
oxidation
thermal stability