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Tribological and Oxidation Behaviour of TiSi(V)N Coatings Deposited by Deep Oscillation Magnetron Sputtering (DOMS)

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The growing environmental concerns and demanding machining processes requiring operations at extreme temperatures has encouraged the development of novel tribological coatings with self-lubricating capability. In recent years, various self-lubricating coatings have been developed by combining hard and wear resistant binary or ternary coatings (such as TiN, TiAlN, CrN, CrAlN, YSZ) with specific elements (e.g. Ag, V) that reduce friction by diffusing to the surface and/or forming a low friction tribolayer on the wear surface. Despite the improvement in friction and wear resistance, the quick depletion of the lubricious specie from the coating system by rapid out diffusion and consequently loss of improved tribological behavior delayed their upscaling to the industry. The aim of this work is to control the diffusion of the lubricious metal (V – which is known to provide lubrication at high temperatures by forming easy shearing V2O5) by using a dual phase nanocomposite coating system (nanocrystalline TiN grains embedded in Si-N matrix) with one of the phases (Si-N) acting as a diffusion barrier. TiSi(V)N coatings with different vanadium content were deposited by DOMS. The oxidation behavior of coatings was studied by thermogravimetry (TGA). Bright field scanning transmission electron microscopy STEM/EDX maps and elemental profiles along the cross section of the oxidized coatings were acquired to understand the kinetics of ions diffusion and oxide scale growth. Tribological behaviour of coatings was characterized in a high temperature tribometer. After wear tests, the wear tracks and wear debris were characterized by scanning electron microscopy with energy dispersive X-ray spectroscopy (SEM-EDS) and Raman spectroscopy. Oxidation resistance of the coatings decreased with V additions. Tribological tests showed that friction and wear rate of coatings decreased progressively with increasing vanadium content.

Keywords
TiSiVN films
DOMS
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