OR1005

Cracking mechanism of CrSiN nanocomposite films: impact on tribological properties

Philippe STEYER[1], Thomas Schmitt[2], Julien Fontaine[3], Nicolas Mary[4], Frederic Sanchette[5], Michael O'Sullivan[6], Claude Esnouf[4]

[1]INSA de Lyon, Villeurbanne, France [2]INSA de Lyon-MATEIS/Ecole Centrale de Lyon-LTDS, Lyon, France [3]Ecole Centrale de Lyon - LTDS, Ecully cedex, France [4] INSA de Lyon - MATEIS, Villeurbanne cedex, France [5]CEA - LTS, Grenoble, France [6] Plansee Composite Materials GmbH, Lechbruck am See, Germany

philippe.steyer@insa-lyon.fr

Recent developments in PVD processes have allowed the achievement of complex-structured ceramic hard coatings. Motivation for such research efforts is to obtain multifunctional coatings, susceptible to meet industrial needs, such as severe machining for instance.
In this study, we focused on ternary nanocomposite CrSiN coatings deposited by cathodic arc evaporation PVD. Our goal is to improve CrN-based coatings durability by modifying, on the one hand, chemistry of the film (0 or5 at.% Si) and, on the other hand, its architecture (single-and multi-layered CrN/CrSiN films: 10 nm periods). Special attention will be paid to mechanisms involved in the formation of the nanocomposite CrSiN structure, and to their consequences on the wear behaviour. Microstructure was investigated by XRD analyses, SEM and TEM observations. Mechanical properties were measured by nanoindentation and with a laboratory-made micro-tensile tests device, which can be implemented into the SEM chamber. Therefore, real-time cracking can then be observed in situ, together with the recording of deformation parameters. Wear behaviour is investigated through tribological tests using a reciprocating ball-on-flat tribometer.
Ternary film shows the expected nanocomposite structure. However, silicon addition leads to a detrimental decrease of the wear resistance in the case of singe-layered coatings, whereas use of the multi-layered structure improves the durability. Neither the hardness nor the strain to failure (H/E) could account for such wear results, as it was already pointed out for TiN/CrN nanolayered films[1]. On opposite, cracking behaviour, discussed according to the Kelly-Tyson's model, was able to explain the beneficial role of the layered structure.
1: C. Mendibide et al., Surf. Coat. Technol. 201 (2006) 4119.

Keywords
in situ real-time approach
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wear resistance
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