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Analysis of the MoS2 supply mechanism of triboactive (Cr,Al)N+Mo:S coatings

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The demands on the performance of components in industrial applications are steadily growing in order to meet current and future expectations of politics and society. The intention is to achieve higher degrees of efficiency while simultaneously lowering costs through longer maintenance intervals. The application of wear resistant and self-lubricating triboactive (Cr,Al)N+Mo:S coatings is a promising approach to ensure a sufficient lifetime of highly loaded components in vacuum and applications under extreme thermal conditions, not allowing the usage of lubricants. The aim of this paper is to analyse the supply mechanism of MoS_2 of (Cr,Al)N+Mo:S coatings in highly loaded tribological contacts under dry-running conditions. The study was conducted using different (Cr,Al)N+Mo:S coating architectures deposited at T ≤ 200 °C on case hardened steel 16MnCr5E (AISI 5115) by using a combination of high power pulse magnetron sputtering (HPPMS) and direct current magnetron sputtering (dcMS). Thereby, Mo and S are present separately in the coating matrix and are supposed to form the solid lubricant MoS_2 in the tribological contact.
The goal was to understand the formation process of the tribochemical reaction layers and the decisive steps of the supply mechanism of MoS_2 on the tribological behaviour. Therefore, the pairing (Cr,Al)N+Mo:S/steel was chosen for tribological analyses. The tests were carried out in a pin-on-disk (PoD) tribometer under dry-running conditions at T = 25 °C and varying contact pressures from 400 MPa ≤ p ≤ 1,300 MPa regarding the application of (Cr,Al)N+Mo:S coatings on gears. In a next step, the wear tracks of the (Cr,Al)N+Mo:S coated specimens were analysed by means of Raman spectroscopy regarding the formation of tribochemical reaction layers. Hereby, there formation and chemical composition are significantly influenced by the contact pressure. The results of the supply mechanism of MoS_2 are correlated with the wear rate and the coefficient of friction.

Keywords
Nitride hard coatings, Wear, Raman spectroscopy, Solid lubrication, PVD