Hybrid process for Cr-N deposition with hollow cathode discharge and plasma immersion ion implantation and deposition

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The combination of thin film growth techniques, such as plasma immersion ion implantation and deposition (PIII&D) and ionized magnetron sputtering (iMS), results in important surface modifications in mechanical and tribological properties, as well as surface defect density and film adhesion. The direct deposition of nitrides and carbides on metallic substrates results in low adhesion, a limiting factor to extend their technological applications [1]. In order to improve adhesion, the use of metallic interlayers between coating and substrate is common [2]. The system adopted in this work associates DCMS, a tube for hollow cathode discharge and PIII. Negative high voltage pulses are applied to the tube, generating a high-density secondary plasma in front of MS target. The same pulses are applied to the substrate, promoting ion implantation. Part of the sputtered particles that pass through the high-density plasma are ionized and implanted in the substrate. In this work, Cr-N films were deposited directly on the carbon steel substrates to evaluate their adhesion. In order to study the influence of the high negative voltage applied to the system, different voltage values were used for each experiment, keeping the gas ratio constant. Adhesion, wear resistance and surface defect density were evaluated by scratch test, pin-on-disk wear test and FE-SEM. Compared to Cr-N films deposited without secondary plasma and ion implantation, the films obtained with this process showed better adhesion, higher wear resistance and lower surface defect density. The excessive increase of the secondary discharge energy showed an influence on the quality of the coating, resulting in low adhesion and high surface defect density.

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References: [1] Z. Han et al., Surf. Coat. Technol. 162 (2003) 189-193.

[2] G. Aldrich-Smith, N.Jennett, J. Housden, Surf. Coat. Technol. 197 (2005) 336-344.