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Corrosion-resistant CrN coatings deposited by different PVD techniques – a comparative study

Martin Drabik¹, Vladimír Ballo¹, Marián Mikula², Martin Truchlý², Tomáš Roch², Pavol Ďurina², Peter Kúš²

¹Staton, Ltd., Turany, Slovak Republic ²Comenius University, Bratislava, Slovak Republic

drabik@staton.sk

Chromium nitride (CrN) is one of the most common coatings in the field of hard wear-resistant coatings due to its favorable mechanical properties like high hardness and chemical inertness. CrN is applied on a large scale as an industrial coating on metal forming tools because of its beneficial friction properties and oxidation resistance. The most common PVD techniques, namely reactive arc evaporation and magnetron sputtering, are successfully used for the production of CrN coatings. Lately, the novel HiPIMS technique brought improvement in adhesion and microstructure of the CrN coatings in comparison to the above mentioned conventional methods. Nevertheless, the microstructure and the chemical composition of the coatings relate closely both to the deposition parameters and these in turn affect the corrosion resistance of the coatings. Furthermore, the deposition temperature often needs to be controlled and maintained below 200 °C in applications where temperature sensitive steels are used.

In this study, CrN coatings deposited by 5 different PVD deposition techniques are compared. Apart of the well-established arc evaporation and dc magnetron sputtering techniques, also the emerging HiPIMS technique as well as its combination with the DC magnetron sputter and finally the latest advanced High Target Utilization Sputtering (HiTUS) technique are used. The deposition process is described by I-V characteristics and OES. SEM and EDX are used to analyze thickness, morphology and chemical composition of the coatings, respectively. Structure of the coatings is investigated using XRD. Mechanical properties are described in terms of hardness, coefficient of friction and adhesion to substrate. Finally, their application performance is evaluated in anti-corrosion tests in various corrosive media.

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Keywords

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protective coating