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ROZPRAWA DOKTORSKA

Charakterystyka struktury i własności powłok przeciwzużyciowych wytworzonych na podłożu ze stali austenitycznej

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Abstract

The aim of this work was to develop a methodology for depositing two-layer coatings consisting of a hard AlCrN nitride layer and a thin low-friction layer (CrCN, MoS_2, DLC:Ti, DLC:Si, TiC) using modified techniques of physical and chemical vapor deposition on a X6CrNiMoTi17-12-2 austenitic steel substrate, as well as examining their structure, mechanical and tribological properties, and assessing the impact of the low-friction layer used on the functional properties of the two-layer coating system. To improve the adhesion between the layers constituting the coating and between the coating and the substrate material, two adhesive interlayers of CrN and/or TiN were used.

A cross-sectional examination of the analyzed coatings performed in a scanning electron microscope confirms that they were properly deposited on the substrate.

The deposited coatings are characterized by good adhesion to the substrate, determined by the appropriate shape of the transition zone between the coating and the substrate material. AlCrN/DLC:Si and AlCrN/TiC coatings demonstrate the highest resistance to abrasive wear, with the values of the friction coefficient μ 0.14 and 0.18, respectively. Following the abrasive wear resistance test using the ball–on–disc method, the weight loss analysis and measurements of the abrasion trace width confirmed their high tribological properties among the tested coatings.

The coatings have a layered structure consisting of a CrN adhesive layer, a hard AlCrN layer, a CrN or TiN adhesive layer, and a suitable low-friction layer (CrCN, MoS_2, DLC:Ti, DLC:Si, TiC). They are characterized by a compact structure, and subsequent layers adhere tightly to the substrate and each other. The adhesive and hard AlCrN nitride layer are nanocrystalline with a columnar structure. Furthermore, CrCN and TiC low-friction layers, are characterized by a nanocrystalline structure, while DLC:Si, DLC:Ti and MoS_2 have an amorphous structure.

The results presented in this paper prove the increase in resistance to abrasive wear and indicate the validity of industrial applications of the analyzed coatings.