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ESTABLISHING THE INFLUENCE OF THE COMPOSITION OF PROTECTIVE WEAR-RESISTANT COATINGS ON WEAR RESISTANCE OF TOOLING

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Modern mechanical engineering requires increased productivity and precision in material processing, which is directly related to the wear resistance of cutting tools. One of the most effective solutions is the application of protective coatings based on refractory compounds. Among these, titanium-based coatings hold a special place, providing a favorable combination of hardness, heat resistance, and oxidation resistance. In this regard, establishing the quantitative influence of coating composition on wear resistance is a relevant scientific and technical task. This determines the direction of research in this area.

The performance of titanium-based protective wear-resistant coatings during the machining of structural steels needs to be investigated. Coatings of various compositions were deposited onto AISI 420 steel specimens by means of magnetron sputtering. Wear resistance tests were carried out during the milling of 45 steel on a modified milling machine, employing a single-tooth face mill equipped with TN-20 cemented carbide inserts. Additionally, microhardness and structural-phase transformations in the coatings were investigated. The tests were performed under controlled conditions.

The experimental results indicate that the coating composition exerts a determining influence on its crystalline structure, residual stress level, and defect density. In particular, single-layer TiC coatings were found to exhibit tensile macrostresses and a predominant crystallographic grain orientation along the $\langle 111 \rangle$ and $\langle 110 \rangle$ directions. The identified structural features account for the enhanced hardness of these coatings, while simultaneously limiting their fracture toughness. These findings are consistent with the physical nature of the materials.

The data obtained demonstrate that the wear resistance of a protective coating under cutting conditions is governed primarily by its composition. Single-layer coatings are advisable for use under relatively stable cutting conditions. For severe conditions characterised by interrupted cutting and the machining of difficult-to-cut materials, preference should be given to two-layer compositions. The best performance was demonstrated by coatings with alternating TiN and TiC layers: the former generates compressive stresses and provides enhanced toughness, while the latter ensures high hardness and wear resistance. The developed mathematical models facilitate the targeted selection of coating composition and subsequent modification parameters in order to achieve maximum wear resistance of the cutting tool. In general, solving such problems requires an integrated approach. The results obtained contribute to the development of this scientific direction.