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# Microstructure, Mechanical and Tribological Properties of (TiTaZrNb)Nx Medium Entropy Nitride Coatings: Influence of Nitrogen Content and Bias Voltage

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**Abstract :** High entropy alloys (HEA) and nitride (HEN) are currently very attractive to the automotive, aerospace, metalworking and materials forming manufacturing industry, among others, for exhibiting higher mechanical properties, wear resistance, and thermal stability than binary and ternary alloys. In this work medium-entropy coatings of TiTaZrNb and the nitrides of (TiTaZrNb)Nx were synthesized on to AISI 420 and M2 steel samples by the direct current magnetron sputtering technique. The influence of the bias voltage supplied to the substrate on the microstructure, chemical- and phase composition of the matrix coating was evaluated, and the effect of nitrogen flow on the microstructural, mechanical and tribological properties of the corresponding nitrides was studied. A change in the crystalline structure from BCC for TiTaZrNb coatings to FCC for (TiTaZrNb)Nx was observed, that is associated with the incorporation of nitrogen into the matrix and the consequent formation of a solid solution of (TiTaZrNb)Nx. An increase in hardness and residual stresses was observed with increasing bias voltage for TiTaZrNb, reaching 12.8 GPa for the coating deposited with a bias of -130V. In the case of (TiTaZrNb)Nx nitride, a greater hardness of 23 GPa is achieved for the coating deposited with a N2 flow of 12 sccm, which slightly drops to 21.7 GPa for that deposited with N2 flow of 15 sccm. The slight reduction in hardness could be associated with the precipitation of the TiN and ZrN phases that are formed at higher nitrogen flows. The specific wear rate of the deposited coatings ranged between 0.5xexp13 and 0.6xexp13 N/m2. The steel substrate exhibited an average hardness of 2.0 GPa and a specific wear rate of 203.2exp13 N/m2. Both the hardness and the specific wear rate of the synthesized nitride coatings were higher than that of the steel substrate, showing a protective effect of the steel against wear.

**Keywords :** medium entropy coatings, hard coatings, magnetron sputtering, tribology, wear resistance
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