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Influence of Ti, Cr, Al and Si constituents in the triological response of industrial vacuum arc coating at 400-500ºC

Gonzalo GARCIA FUENTES, Argyrios Georgiadis, Eluxka Almandoz, José Fernández

AIN, Cordovilla, Spain

gfuentes@ain.es

TiAlN, TiAlSiN, CrTiAlN are coating formulations already in use by the industry for several manufacturing tool elements such as hot forming, or high speed machining. More specifically, hot forming technologies such as blank stamping, or die casting requires the use of tough wear resistance steels able to operate at high contact pressures under cycling temperatures between 400ºC-500ºC. PVD coatings enhance the surface properties of these tooling elements, therefore, the understanding of the tribological response of these films as a function of the elemental constituents is of key relevance to achieve optimal formulations for each specific application.
In this study, a series of coating formulations have been deposited in an industrial vacuum arc evaporation on hot work steel substrates (AISI H13). The films have been tested in a Universal tribometer at temperatures between RT and 500ºC, and the wear phenomena investigated as a function of the coating stoichiometries. At these temperature ranges, the tribological response of the coatings depend on the chemical reactions ocurring on the contact zones between the films and the counterbodies. The chemical reactions as inspected by SEM and elemental analyses, exhibit differences depending on the film stoichiometries. For example, the presence of Al in TiAlN films favours the formation of oxides on the contact zones, which provides tribological protection at high temperatures with respect to that shown by TiN. The tribological response of the films shall be also investigated in terms of the ratio Cr/Ti and the alloying of the TiAlN system with Si. Other coating properties such as roughness, nano-indentation hardness, or adhesion strength shall be taken into account to provide a solid interpretation of the results.

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