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Failure Mechanisms of Chromium-Nitride (CrN) Coatings

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The use of coatings in industrial applications is increasing, due to the fact that performance to wear has been satisfactory established in practice. However, the foreknow of fail mechanisms of these coatings is not yet done adequately. The present paper aims to present a fail chart for the Chromium-Nitride [1] coating, used for cutting, applied on an high speed steel [2] substrate. The material of the spherical indentor used in testings was Tungsten-Carbide [3] and the numerical simulation software used was ANSYS, v. 5.7, developed by Swanson Analysis System Inc. The variables used in the analysis were coating thickness and their Young Modulus. In order to validate the model, an analysis has been performed and the results have been compared with the classical Hertz theory. The location of maximum shearing stress in each case was identified and related with its plausible failure modes. The results show that the increase of CrN coating thickness lean to the transfer of failure from substrate to coating, in other words, from plasticity to adhesion and/or microcracking. Besides, raising the coating Young modulus, the load is transferred from the subsrate to the coating. The intended use determines the coating thickness. Extremely thin coatings do not have satisfactory mechanical response. Thick coatings perform as solid bodies of Chromium-Nitride.

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