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Tribological Study of Molybdenum Nitrides Under the Effect of Vanadium

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Our study of the MoVN ternary thin films has the objective of improving certain tribological and mechanical characteristics and of finding the appropriate stoichiometry to have the microstructure that corresponds to the desired properties using the characterization techniques: SEM -XRD-EDS-XPS- WDS. Nano-indentation and the scrash-test. Note that wear and friction resistance does not depend on the internal characteristics of the materials in contact as is usually the case for mechanical properties, but rather depends mainly on the structure and morphology and experimental conditions. Hypotheses will be presented in order to explain the tribological behavior of deposits and to match them to their physicochemical and mechanical properties. The EDS-XPS microanalyses revealed that the atomic ratio (N/V) ~ 1 for VN, that (N/Mo) = 1.22 for MoN and that (N/(Mo + V)) = 1 for the MoVN ternary films.

From this figure we find that the MoN film has an average coefficient of friction of 0.65. This film then has good wear resistance. Comparing this value with that obtained on MoN coatings deposited by the Alcatel PVD sputtering system on AISI substrate, (which is of the order of 0.45) therefore better than that deposited on XC100 and Si . This variation can be explained by the nature that differs between the coating/substrate interface and the other links that are generated. By comparing the Mo-V-N and MoN films, we can then say: increasing the V content in the Mo-V-N film is more favorable for the production of films with a low average value of the coefficient of friction. Which remains lower than that of MoN film (0.65)? So this is regular with the mechanical properties.

Keywords: Microstructure, Covers, PVD, Morphology, Coefficient of friction, Tribology.

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1. INTRODUCTION

The needs for the industry in cutting devices endowed with a hardness and an excellent wear resistance, led, for several years in the development of thin layers of nitrides of metals of transition (TiN, CrN, MY) put down by physical processes in phase vapor (PVD) These techniques allow to put down a superficial layer which brings remarkable improvements in the holding in service of the mechanical parts, particularly the cutting devices, These technologies are connected to the space, we also call them the nanotechnologies. The latter constitute surface treatments by application of covers in thin layers << 10 μm of thickness [1]. A considerable attention in several laboratories was just concentrated to study these covers with the vision to prepare a harder material than the diamond, Consequently, the physical limit for the maximum of the increase of the hardness in covers nano composite stays an open question, which is extensively studied in many laboratories [2]. The texture is strongly influenced by the conditions of deposits (preceded to elaboration, temperature, pressure of gases, tension of polarization, the hardness and the tribological properties optimized are most of the time the first ones to be considered because of the potential application of these layers in the field of the manufacturing. Parts dressed in materials with molybdenum are not enough studied during these last decades. In spite of their good mechanical properties, these covers did not find applications in the industry. Indeed, compared with the nitride of chromium, they present a coefficient of rather weak friction. The formation of oxides of high-temperature Mo allows to reduce the friction .Furthermore; Cr, Mo and N are important elements of addition allowing the hardening of the metallic alloys and the formation of passive films to fight against the chemical corrosion [3]. And a good adhesion to the steel substrata because of the solubility of Mo in the ferrous alloys [4] consequently. Ti-C-N is wear resistant abrasive and in the oxidation until a temperature about 800 °C. Shan and al. [5] indeed demonstrated that the brush resistance of these films against a steel ball was better that that of the film of TiN, because of its higher hardness and in the presence of the Carbon. Nitrides of metals of transitions (TiN, CrN, ZrN) their covers possess one High melting point, a high value of hardness and a big wear resistance, were widely studied During these last years and found of numerous Industrial applications. As well as TiN, the addition of Si in the ZrN resulted in a structure of cover nano composite in this study the moderate pure hardness of the cover ZrN (38GPa) is extremely raised compared with the values reported usually in the literature [6]. The moderate sizes of grains exactly are not reported, but are said varied between 10 and 20 nm according to the concentration of silicon. Pilloud and Al [7] found that the addition of Si in the ZrN makes decrease only the moderate hardness, slightly for low concentrations Si (< 3.5 %), then largely with the addition of more Si. We show that if the internal constraints are too important, it is them who control the crystalline organization of the growing deposit ,and

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