11th International Conference
on Advanced Materials

ICAM 2009

Rio de Janeiro Brazil
September 20 - 25

Low-Friction TiN/ MoS_2 Nano-structured coatings investigated before and after tribological application

G. Strapasson[(1)*], C. A. Figueroa[(1)], G. V. Soares[(1)], R. L. O. Basso[(1)] , I. J. R. Baumvol[(1,2)] and E. K. Tentardini[(1)]

(1) CCET, Universidade de Caxias do Sul. Av. Francisco Getúlio Vargas 1130, 95070-560 - Caxias do Sul - RS, Brazil, e-mail: gilmarastr@hotmail.com
(2) Universidade Federal do Rio Grande do Sul, Instituto de Física, Porto Alegre, Brazil
* Corresponding author.

Abstract – Nowadays, there is a demand in industry for better wear resistant coatings to extend the lifetime of machine parts and cutting tools. One possible solution for this problem is using TiN /MoS_2 coatings with excellent tribological properties and low friction coefficient. In this work, different TiN/Mos_2 coatings have been produced by dc magnetron with MoS_2 concentrations between 1 and 40 at%. The coatings structural properties were evaluate with XRD, RBS and XPS analysis. The coatings structural properties were evaluate with XRD, RBS and XPS analysis. Results by XRD (Fig. 1) show the increase of concentration shifts the TiN Bragg peaks to lower angles, while no shifting in MoS_2 Bragg peaks were detected. By XPS, analysis show Ti-N (Fig. 3) and Mo-S (Fig.2) chemical bonds in the form of TiN and MoS_2.

Multicomponent coatings formed by a hard matrix and solid lubrificant nanoparticles are a new generation of the films to use in dry machining parts, basically due to a reduction of friction coefficient, but maintaining matrix coating mechanical properties. Also, there is a need for development of a coating that enables less usage of liquidid lubrificant, solid lubrificant such as MoS_2 [1-2] has been exploited a lot to replace the liquidid lubrificant. An extensive studied nano-structered composite coating such as TiN/ MoS_2, presents a combination of excellent tribological properties with friction coefficient less than 0.1.

However, the chemical interactions among different element and the crystalline structure of TiN/ MoS_2 system are not fully understood. Previous works reports the possibility of a replacement of N by S in TiN lattice, with a MoS_2 formation just after tribological application. Although some authors report the existence of MoS_2 particles disperse in the TiN structure.

In the present work, TiN /MoS_2 thin films with different MoS_2 concentrations between 1 and 40 at% were deposited by reactive dc magnetron sputtering using individual TiN and MoS_2 targets. Mechanical and physico-chemical properties of these coatings were analyzed by XPS, RBS, XRD and nanohardness techniques before and after tribological application.

Results show that hardness figures stabilize at 10 GPa with concentration up to 10 at% of MoS_2. By XRD (Fig. 1), the increase of MoS_2 concentration shifts the TiN Bragg peaks to lower angles, while no shifting in MoS_2 Bragg peaks were detected. By XPS analysis show Ti-N (Fig. 3) and Mo-S (Fig. 2) chemical bonds in the form of TiN and MoS_2 stoichiometric compounds, without detection of any other chemical interaction among Sulfur or Molybdenum besides MoS_2, proving the occurrence of this compound before plastic deformation.

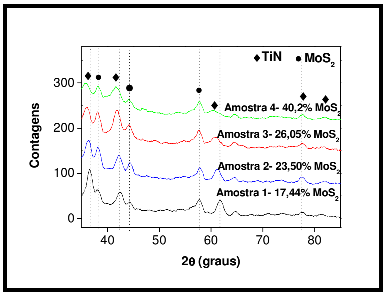

Figure 1: XRD of TiN- MoS_2 films deposited with different MoS_2 concentrations.

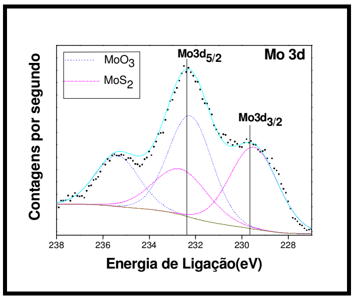

Figure 2: XPS spectrum of the Mo 3d.

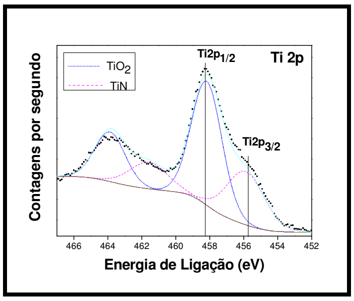

Figure 3: XPS spectrum of the Ti 2p.

References

[1] R. Goller, P. Torri, M. A. Baker, R. Gilmore and W. Gissler Ronning, Surf. Coat. Technol. 120-121 (1999) 453-457.
[2] S. K. Kim and B. C. Cha. Surf. Coat. Technol. 188-189 (2004) 174-178.