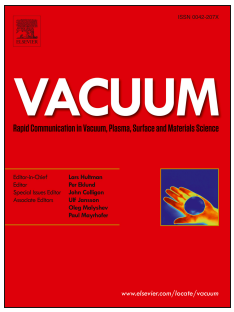
Accepted Manuscript



Influence of Al content on microstructure, mechanical and tribological properties of Ti-W-Al-N composite films

Lihua Yu, Jian Chen, Hongbo Ju, Hongzhi Dong, Hongjian Zhao

PII: S0042-207X(16)30810-7

DOI: 10.1016/j.vacuum.2016.11.004

Reference: VAC 7186

To appear in: *Vacuum*

Received Date: 11 March 2016

Revised Date: 2 November 2016

Accepted Date: 4 November 2016

Please cite this article as: Yu L, Chen J, Ju H, Dong H, Zhao H, Influence of Al content on microstructure, mechanical and tribological properties of Ti-W-Al-N composite films, *Vacuum* (2017), doi: 10.1016/j.vacuum.2016.11.004.

Influence of Al content on microstructure, mechanical and tribological properties of Ti-W-Al-N composite films

Lihua Yu*, Jian Chen, Hongbo Ju, Hongzhi Dong, Hongjian Zhao

School of Materials Science and Engineering, Jiangsu University of Science and Technology, Mengxi Road 2, Zhenjiang, Jiangsu Province, 212003, China

Abstract: Ti-W-Al-N films with various Al content (0 at.% ~ 12.4 at.%) were deposited by reactive magnetron sputtering. The composition, microstructure, mechanical and tribological properties of Ti-W-Al-N films were investigated by EDS, XRD, HRTEM, SEM, Nano-indentation, Ball-on-disk tribometer. It is found that Ti-W-Al-N films consist of Ti-W-Al-N phase, Ti_2N phase and W_2N phase below 2.9 at.% Al. Ti_2N phase disappears at 5.6 at.% Al and h-AlN phase forms at 12.4 at.% Al respectively. The hardness firstly increases and then decreases with increasing Al content and the highest hardness is 35.7 GPa at 8.7 at.% Al. At room temperature, the friction coefficient continuously increases, whereas the wear rate firstly decreases and then increases with increasing Al content. The lowest wear rate of 1.79×10^{-8} $mm^3N^{-1}mm^{-1}$ is obtained at 8.7 at.% Al. As the temperature increases from room temperature to 700 □, the friction coefficient firstly increases and then decreases, while the wear rate gradually increases. The tribological properties of the film depended on the testing temperatures significantly because the testing temperatures influenced the hardness, the tribo-films and wear mechanism of the film.

Keywords: reactive magnetron sputtering; microstructure; mechanical property; tribological property

1. Introduction

Over the past decade, the development of nanostructured composite films has resulted in considerable improvement in comparison to single hard films (TiN, ZrN, CrN, etc) in terms of their outstanding performance[1-3]. Recently, TiWN films have been widely