

Accepted Manuscript

Influence of annealing on the microstructure and mechanical properties of MTCVD $\text{TiC}_{0.79}\text{N}_{0.21}$ coating

Lianchang Qiu, Yong Du, Zhiqiang Zhong, Haidong Shi, Layyous Albir

PII: S0042-207X(17)30983-1

DOI: [10.1016/j.vacuum.2017.10.040](https://doi.org/10.1016/j.vacuum.2017.10.040)

Reference: VAC 7679

To appear in: *Vacuum*

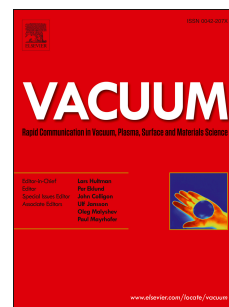
Received Date: 24 July 2017

Revised Date: 20 September 2017

Accepted Date: 27 October 2017

Please cite this article as: Qiu L, Du Y, Zhong Z, Shi H, Albir L, Influence of annealing on the microstructure and mechanical properties of MTCVD $\text{TiC}_{0.79}\text{N}_{0.21}$ coating, *Vacuum* (2017), doi: 10.1016/j.vacuum.2017.10.040.

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



Influence of annealing on the microstructure and mechanical properties of MTCVD

TiC_{0.79}N_{0.21} coating

Lianchang Qiu^a, Yong Du^{a,*}, Zhiqiang Zhong^a, Haidong Shi^b, Layyous Albir^c

^a State Key Laboratory of Powder Metallurgy, Central South University, Changsha, Hunan 410083, PR China

^b Ganzhou Achteck Tool Technology Co., Ltd., Ganzhou, Jiangxi 341000, PR China

^c Layyous Consulting Ltd., Miilya 25140, Israel

* Corresponding author. Tel.: +86 731 88836213; fax: +86 731 88710855

E-mail address: yong-du@csu.edu.cn (Y.Du).

Abstract

TiC_{0.79}N_{0.21} coating was deposited on WC-Co cemented carbide by moderate temperature chemical vapour deposition technique and then annealed in vacuum or air in the temperature range of 700 -900 °C for one hour. The morphology, composition, phase component, residual stress, hardness and plastic deformation resistance of the coating before and after annealing were investigated by scanning electron microscopy (SEM), transmission electron microscopy (TEM), electron probe micro-analyzer (EPMA), X-ray diffractometer (XRD) and nano-indentator. The results show that after annealing in low vacuum, the grain boundaries of the coating surface are still clearly visible and small capsule or granular oxide particles are uniformly distributed on the columns surfaces of the coating. Coarse irregular particles enriched with W element are randomly located at the grain boundaries. After annealing in air, the coating is, however, oxidized to rutile TiO₂ and oxidation rate increases with temperature. Dramatic coating oxidation is observed at 900 °C. With the increase of temperature, the residual tensile stress increases and compressive stress decreases after annealing in air and vacuum, respectively. The hardness and plastic deformation resistance on the cross section of coating are improved with temperature after vacuum annealing while opposite tendency is obtained for air annealing.

Keywords:

Annealing; Chemical vapor deposition (CVD); TiC_{0.79}N_{0.21}; Residual stress; Hardness

1. Introduction

Ti(C,N) is one of the widely used coating materials due to its high hardness and outstanding wear resistance. Various Ti(C,N) coatings have been prepared and characterized [1-8]. MTCVD (Moderate temperature Chemical Vapor Deposition) Ti(C,N) coated inserts are known to show increased toughness [5, 9-10]. The MTCVD Ti(C,N) coatings often present a columnar structure with columns that grow throughout the coating. Many efforts have been made on adjusting the properties of Ti(C,N) coatings. It was found that the cutting performance of MTCVD Ti(C,N) coating was improved by 30~60% during continuous turning of carbon steel, alloyed steel and stainless steel by introducing C₂H₄ gas to a TiCl₄-CH₃CN-H₂ precursor system [6]. Fine grain sized microstructure (50-300 nm) together with equiaxed grain morphology increases the toughness of the Ti(C,N) coating without decreasing its wear resistance [11]. According to [12], MTCVD Ti(C,N) coating with a maximum hardness of about 40 GPa was obtained by doping Si (12 at. %) from TiCl₄, SiCl₄ and CH₃CN and H₂ gas system.

Numerous works have been done about the effect of annealing on the microstructure and mechanical properties of TiN, TiC and Ti(C,N) coatings. Many papers on annealing can be found for TiN coatings prepared by both PVD (Physical Vapor Deposition) and CVD methods. It is reported that annealing in air caused TiN coating oxidation at temperatures above about 450 °C [13]. The stresses within coating contributed to coating degradation at higher annealing temperatures. Indentation hardness was reduced

Download English Version:

<https://daneshyari.com/en/article/8044670>

Download Persian Version:

<https://daneshyari.com/article/8044670>

[Daneshyari.com](https://daneshyari.com)