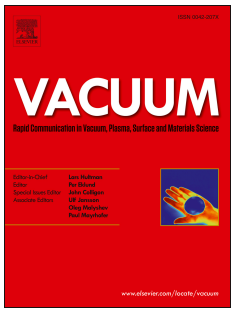
Accepted Manuscript



Deposition of thin tungsten carbide films by dual ion beam sputtering deposition

Fei Zhu, Zhi-lei Chen, Ke-zhao Liu, Wei Liang, Zhengjun Zhang

PII: S0042-207X(18)30495-0

DOI: 10.1016/j.vacuum.2018.08.023

Reference: VAC 8170

To appear in: *Vacuum*

Received Date: 2 April 2018

Revised Date: 13 August 2018

Accepted Date: 14 August 2018

Please cite this article as: Zhu F, Chen Z-l, Liu K-z, Liang W, Zhang Z, Deposition of thin tungsten carbide films by dual ion beam sputtering deposition, *Vacuum* (2018), doi: 10.1016/j.vacuum.2018.08.023.

Deposition of thin tungsten carbide films by Dual ion beam sputtering deposition

Fei Zhu [a], CHEN Zhi-lei [b, &], LIU Ke-zhao [b], Wei Liang [c], Zhengjun Zhang [c, *]

[a] Department of Engineering and Physics, Tsinghua University, Beijing 100084, PR China

[b] Science and Technology on Surface Physics and Chemistry Laboratory, Jiangyou, Sichuan, China

[c] Collaborative Innovation Center of Advanced Nuclear Energy Technology, Key Laboratory of Advanced Materials(MOE), School of material science and Engineering, Tsinghua University, Beijing 100084, PR China

*Corresponding author , E-mail: zjzhang@tsinghua.edu.cn

[&] This author contributed equally to this work and should be considered co-first authors

Abstract

Hard materials coating fabricated by physical vapor deposition techniques methods are wildly used because of their excellent mechanical strength, stability and chemical resistivity. In this article, compact and high Young's modulus tungsten carbide films with ~100nm thickness were prepared on Si (100) substrates by dual ion beam sputtering deposition method, and elucidates the influence of deposition temperature and assistant ion source on the adhesion strength and Young's modulus of tungsten carbide thin films. Morphological analysis, composition, and structure of tungsten carbide films were investigated by Atomic force microscope, X-ray photoelectron spectrometry, Scanning electron microscope. The X-ray diffraction analysis shows that the thin films comprise of hexagonal structure W_2C. The adhesion strength is improved due to ion beam source bombardment and elevated deposition temperature. The Young's modulus of the film is codetermined by the density, microstructure and crystal structure. The influence of density, microstructure and crystal structure on Young's modulus was discussed in detail. The Young's modulus is improved due to the more compact structure caused by appropriate assistant source bombardment and elevated deposition temperature, and gets degradative due to the disorganized, coarse and granular structure caused by overlarge assistant source bombardment.

Keywords: Dual ion beam sputtering deposition; tungsten carbide; adhesion strength; Young's modulus