

TiNbN / AlTiNbSiN / CrN Multilayer Coatings Irradiated by 300 keV Ar⁺ Ions: The Role of Nitrogen

Kuan-Che Lan^{1,2*}, Chun-Hung Hsiao², Yin-Yu Chang³

¹ Institute of Nuclear Engineering and Science, National Tsing Hua University 101, Section 2,
Kuang-Fu Road, Hsinchu 300044, Taiwan

² Department of Engineering and System Science, National Tsing Hua University 101, Section 2,
Kuang-Fu Road, Hsinchu 300044, Taiwan

³ Department of Mechanical and Computer-Aided Engineering, National Formosa University, No.
64, Wunhua Road, Huwei Township, Yunlin County 632301, Taiwan

Corresponding author's e-mail: kclan@mx.nthu.edu.tw

ABSTRACT

To study the crystalline stability of nitride coating against heavy ion irradiation for nuclear-related applications, nitride multilayer coatings with the architecture of TiNbN/AlTiNbSiN/CrN of an average period of 25 nm deposited by cathodic arc deposition were irradiated with 300 keV Ar⁺ ions at the initial of room temperature under vacuum to the damage levels upto 7 dpa (displacements per atom). The irradiation-induced the change in crystalline structure, composition, and mechanical properties and electrical properties were systematically investigated. Ar⁺ ions irradiation, noticeable interdiffusion between adjacent layers was observed. The region of depth exhibited a decrease in nitrogen content after irradiation which is consistent with the prediction of SRIM simulation. The reduction in hardness, electrical conductivity of the coating has been monitored. Besides, post irradiation examination of TEM and APT were carried out to investigate the depth distribution of irradiation induced defects at atomic level resolution. The defects of the role of nitrogen behavior of the properties among a variety of nitride with in the multilayer coating.

Keywords: Multicomponent nitride coatings, Multilayer thin films, Heavy-ion irradiation, Preferential sputtering, Cathodic arc deposition