Nanocomposites and nanomaterials

Mechanical characteristics of nitride coatings, deposited by magnetron and vacuum-arc methods

V.A. Belous, G.N. Tolmachova, A.S. Kuprin

National Science Center "Kharkov Institute of Physics and Technology", Akademicheskaya St. 1, 61108 Kharkov, Ukraine.
E-mail: tolmachovagn@kipt.kharkov.ua

Creating by ion-plasma methods of wear resistant nanostructured coatings based on transition metal nitrides with a combination of optimum properties: hardness, elastic modulus, fracture toughness etc., is an actual problem for the industry.

The aim of this work is the study and comparison of the physical and mechanical characteristics of various nitride coatings with crystallite size from 5 to 60 nm, obtained by vacuum-arc deposition of filtered plasma (*fvad*) and magnetron sputtering (*ms*) with bulk nitride crystals. Mechanical tests were carried out on the Nano Indenter G200 device, using CSM (continuous stiffness measurement) mode for continuous monitoring of contact stiffness, which allowed controlling the hardness and elastic modulus by the depth of penetration of the indenter [1]. Indentation depth does not exceed 10% of the thickness of coatings.

The results of measured hardness and Yung's modulus (in GPa) are shown in table.

Composition	TiN	ZrN	AlN	TiAlZrN	TiZrN
bulk	25 (460)	24 (400)	14 (250)	-	-
ms	26-28 (250-300)	19-21 (230-250)	15 (200)	20-26 (220-250)	26 (230)
fvad	38-44 (480-500)	27-35 (350-400)	32 (350)	26-35 (415-433)	39 (449)

Vacuum arc coating has a superior hardness and Young's modulus than magnetron coatings and bulk samples of nitrides. At the same time the magnetron coatings have higher hardness and a lower Young's modulus than the bulk samples.

1. *Oliver W., Pharr G.* Measurement of hardness and elastic modulus by instrumented indentation: advances in understanding and refinements to methodology // J. Mater. Res. – 2004. – **19,** N 1. – **P**. 3–20.