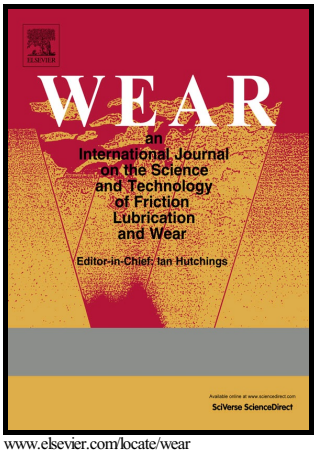
Delamination and longitudinal cracking in multi-layered composite nano-structured coatings and their influence on cutting tool life

A.A. Vereschaka, S.N. Grigoriev, N.N. Sitnikov, Andre Batako



www.elsevier.com/locate/wear

PII: S0043-1648(17)30626-9
DOI: http://dx.doi.org/10.1016/j.wear.2017.07.021
Reference: WEA102218

To appear in: *Wear*

Received date: 13 April 2017
Revised date: 4 July 2017
Accepted date: 29 July 2017

Cite this article as: A.A. Vereschaka, S.N. Grigoriev, N.N. Sitnikov and Andre Batako, Delamination and longitudinal cracking in multi-layered composite nano structured coatings and their influence on cutting tool life, *Wear* http://dx.doi.org/10.1016/j.wear.2017.07.021

Delamination and longitudinal cracking in multi-layered composite nano-structured coatings and their influence on cutting tool life

A.A. Vereschaka[1], S.N. Grigoriev[1], N.N. Sitnikov[2,3] and Andre Batako[4]

[1]Moscow State Technological University STANKIN, Vadkovsky per. 1, Moscow, 127994, Russia

[2]Federal State Unitary Enterprise "Keldysh Research Center", Onezhskaya St. 8, Moscow 125438, Russia

[3]National Research Nuclear University MEPhI (Moscow Engineering Physics Institute), Kashirskoe shosse 31, Moscow 115409, Russia

[4]Liverpool John Moores University (LJMU), Liverpool, UK

Abstract. This paper presents the results of a study of the mechanisms of delamination and the formation of longitudinal cracks in the structure of multi-layered nano-structured coatings to predict the mechanisms for further improvement of tool life and the reliability of metal-cutting tools. Various mechanisms of formation of longitudinal cracks and delaminations in coatings on rake and flank tool surfaces, which vary based on the compositions and architectures of the coatings, are addressed. In addition, the influence of internal defects, including embedded microdrops and pores, on the formation of cracks and delaminations and the failure of coatings is discussed. The importance of ensuring a balance of the basic properties of coatings to achieve high wear resistance and maximum tool life of coated metal cutting tools is shown. The properties of coatings and the natures of their failures, as investigated during scratch testing and dry turning of steel C45, are provided.

Keywords: wear-resistant coatings; wear; crack; fracture; tool life; PVD coatings; delamination; nanoscale structures

Nomenclature

NMCC - nano-scale multi-layered composite coatings

FCVAD - filtered cathodic vacuum arc deposition

FEM - finite element method

VCCT - virtual crack closure technique

SERR – strain energy release rate