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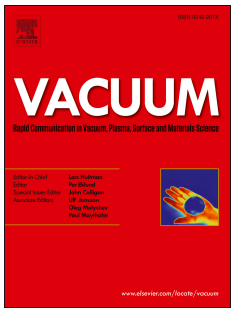

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Investigation of the structure and properties of PVD coatings and ALD + PVD hybrid coatings deposited on sialon tool ceramics

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Abstract

It was shown in the paper that the operational properties of sialon tool ceramics coated PVD coatings, both in conventional process as well as in hybrid ALD/PVD process, depend mainly on their adhesion to the substrate. The paper presents researches of coating structure made using scanning and transmission electron microscopy. Phase composition analysis was carried out using XRD methods as well as electron diffraction in TEM. Analysis of the chemical composition in coatings micro-areas was made using the EDS method. The microhardness and adhesion of coatings to the substrate were also investigated. Researches shown that the coating of (Ti,Al)N deposited in a hybrid process, i.e. with the prior formation of the ZnO layer by the ALD technique on a ceramic substrate, to ensure the possibility of substrate polarization during the PVD process, makes it possible to obtain coating with significantly better adhesion and better exploitative properties in comparison with a coating (Ti,Al)N obtained by the conventional method. In addition, it was found that the high adhesion and very good exploitative properties of coating (Al,Ti)N are undoubtedly connected with the existence of intermediate zones between the substrate and the coating.

Keywords: PVD, ALD, hybrid coatings, tribology, TEM

Introduction

Machining is still one of the most important technologies used in machine construction, despite the intensive development of other manufacturing technologies. Even when cold or hot plastic forming or casting technology is applied, the final forming is usually done by machining. Ceramic tool materials used for machining difficult-to-cut materials exhibit high hardness, wear resistance and chemical stability at high temperature. These types of tools are being used for machining without cooling lubricant using higher cutting parameters than in the case of high speed steel tools or cemented carbides. Economic and ecological aspects are the main factor influencing constant desire to increase machining efficiency, which can be achieved by increasing the thickness of the material taken off at single pass and shortening transit

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