PROCEEDINGS OF THE INTERNATIONAL CONFERENCE NANOMATERIALS: APPLICATIONS AND PROPERTIES
Vol. **3** No 1, 01FNC07(2pp) (2014)

Research of Thermal Stability of Tapes of Diboride of Hafnium and Receipt of Optimization Model of Cutting Process

A.V. Agulov [1,*], L.V. Vasileva [2,†], A.A. Goncharov[1], V.A. Stupak[2], V.V. Petukhov[1]

[1] *Donbas State Machine-building Academy, 72, Shkadinova Str., 84313 Kramatorsk, Ukraine*
[2] *Donetsk National University, 24, University Str., 83055 Donetsk, Ukraine*

(Received 28 July 2014; published online 29 August 2014)

The short analysis of thermal stability and features of structure and physical-mechanical descriptions of thin wearproof coverages is executed on the basis of diborides of transitional metals, under act of high temperatures.

The optimization model of cutting process is presented by the hard-alloy plate of T15K6 with nanocrystalline tape of diboride of hafnium, by possessing the best physical-mechanical descriptions nanohardness of H = 44,5 GPa and module of resiliency of E = 396 GPa.

Keywords: Nanohardness, Thermal stability, Transitional metals.

PACS number: 68.47.De

1. INTRODUCTION

Sheeting on the basis of nitrides and carbides of transitional metals, presently are the inexpensive method of increase of the productivity of toolpiece. One of major factors influencing on actuality of this research is a feature of nanostructural tape to go across under act of high temperatures from one structural state in other. Thus in the process of transition, under act of high temperatures arising up in area of contact a "instrument is a purveyance", in the process of treatment physical-mechanical descriptions of sheeting change. For this reason, actuality of research of stability of composition, structure and properties of boride and boronitrides coverages increases.

In-process [1] a study of thermal stability of tapes of diboride of hafnium was undertaken in the process of the high temperature annealing on air on substrate from steel of 12X18H9T and hard-alloy plate of T15K6. A receipt and research of structure, phase and element composition of tapes of diboride of hafnium, having a columnar structure and texture of height a plane (00.1) on substrates from stainless steel of 12X18H9T, was conducted on the methodology before described in works [2,3]. The standards of the prospected coverages had next descriptions: thickness of 1,3 - 1,5 mkm, hardness of H = 44,5 GPa, module of resiliency of E = 396 GPa. Annealing came true in a vacuum stove of СНВЭ-1.3.1/16 and at T_{on} = 600, 700, 800, 1000°C.

At research of thermal stability of pellicle coverage on substrate from T15K6, it was noticed that the process of forming of oxydic coverage takes place like as well as on substrate from steel. At the increase of temperature of 800°C and further до1000°C, during 1 hour, a picture does not differ cardinally, it was marked, only increase of thickness of oxydic layer to 600 nm. - i.e. we see a next picture: the coniferous forest on the surface of coverage burns down practically fully, his place occupies oxygen.

2. RESULTS AND DISCUSSION

As results of researches show, in the process of annealing of tape of HfB_2 on air, there is formation of oxydic layer of HfO_2, here, with the height of intensity of oxydic peaks on diffractograms, it is possible to notice the change of concentration of oxygen and coniferous forest on the depth of tape. Thus, in the process of annealing pellicle coverage gets an oxydic layer on the surface of tape, the thickness of layer is varied from 200 to 600 nm.

C of point of view of practical application, has interest of research of kinetics of process of the high temperature annealing on air, depending on a temperature and time of annealing. The obtained data can present large interest for application of this class of coverages as protective in treatment metals cutting, as a cutting process takes place in an air environment, and, knowing kinetics of destruction of coverages, it will be possible without the special labour to forecasting the period of firmness and time to complete breakage of instrument.

For a decision the set problem the optimization model of cutting process was created. Rationally it was to use the ortogonal central composition plan (OCCP) of 2th order, that allows not only to form the function of response as a complete quadratic polynomial but also execute optimization of parameters during realization of experiment. Advantage of the chosen plan of optimization are objectivity and informative capacity of experiments [4]. As a dependent parameter of Y the value of firmness was examined Ton, min Area the researches and basic factors, included in a model, and also the intervals of their varying were chosen on the basis of before undertaken studies [5]. Two basic factors are preliminary distinguished: X_1 – speed of cutting of v, m/of mines and X_2 is an index of plasticity of H/E.

* agulov@ukr.net
† applmath@dgma.donetsk.ua

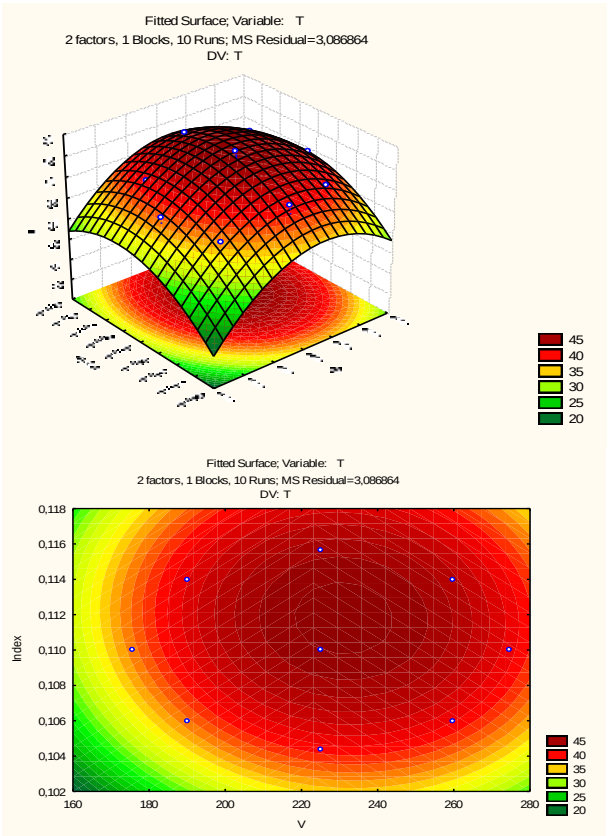

Fig. 1 – Graphic Arts : a) surface of response; b) contour chart.

As a result of treatment of information adequate equalization of function of response is got, to relating a value firmness with the factors of speed of cutting and index of plasticity :

$$Y = -1680{,}8 + 1{,}4177x_1 - 0{,}00306x_1^2 + 27956{,}34x_2 - 124992{,}39x_2^2$$

Homogeneity of dispersion was checked up on the criterion of Kokhrena, model adequacy - on F- to the criterion of Fisher.

On the basis of the got model it maybe to optimize the prospected parameters, and also to find the values of factors for the desired value of firmness. Preliminary conclusions about optimal values it is possible to do on the basis of study of charts of surface of response (pic.1a) and corresponding contour chart (pic.1b).

3. CONCLUSIONS

Thermal stability of thin wearproof nanostructures is studied on the basis of diboride of hafnium.

The optimization model of cutting process is got by the hard-alloy plate of Т15К6 with nanocrystalline tape of diboride of hafnium.

Undertaken studies showed possibility of the use of ortogonal central composition plan of 2th order for the receipt of optimization model of cutting process. The got results can serve as base in further comparative researches on determination of the rational modes of cutting by a hard-alloy plate with coverage nanocrystalline tape of diboride of hafnium.

REFERENCES

1. A.V. Agulov, A.A. Goncharov, V.A. Stupak, V.V. Petukhov, *Inorg. Mater.* **50** No 5, 499 (2014).
2. A.A. Goncharov, A.V. Agulov, V.A. Stupak, V.V. Petukhov, *Inorg. Mater.* **47** No 6, 666 (2011).
3. S.N. Dub, A.A. Goncharov, S.S. Ponomarev *Superhard Mater.* **3**, 9 (2011).
4. Y.P. Adler. *Planning of experiment at the search of optimal terms* (Moscow: Science: 1976).
5. A.A. Goncharov, S.N. Dub, A.V. Agulov *FMM* **114** No 1, 105 (2013).