

PHYSICAL DEPOSITION OF COATINGS IN VACUUM

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ABSTRACT

The article presents the process of fphysical deposition of coatings in a vacuum, which consists of spraying a substance in a special vacuum chamber. As well as the main operations of a typical technological process for applying coatings using the PVD method.

KEYWORDS

Physical deposition, coating, vacuum, ionization, magnetron sputtering, ion beam, electron beam.

Introduction

Physical deposition of coatings in a vacuum involves spraying a substance in a special vacuum chamber. The sprayed particles are then ionized, atare hunkering down V ehlectical pOle V n Acoating of the product. Then the substance condenses on the surface in the presence of a reaction gas. The transformation of the solid into a metal vapor can be carried out by a cathode spot of a vacuum arc, by vacuum-arc evaporation (Fig. 1, a); by an ion beam, by magnetron sputtering (Fig. 1, b); by an electron beam, by electron-beam evaporation (Fig. 1, c) in the temperature range of 500-600□WITH. Most often, refractory metals (Ti, Cr, Mo, Zr, Al, etc.) are applied to the substrate, and nitrogen, methane, and oxygen are used as reaction gases, and coatings are obtained in the form of nitrides, carbides, carbonitrides, or oxycarbides of refractory metals (Table 1). [1,2].

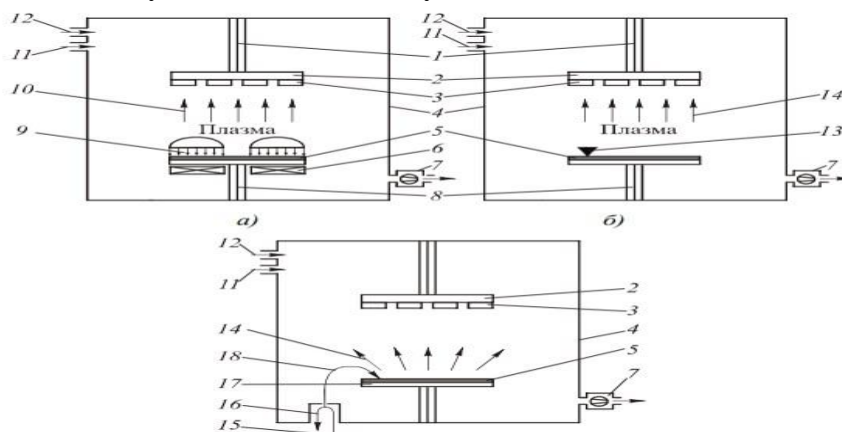


Figure 1 – Basic diagrams of coating application on cutting tools using PVD methods

*a – magnetron sputtering; b – vacuum arc evaporation; c – electron beam evaporation; 1 – bias voltage supply; 2 – tool holder; 3 – tool; 4 – vacuum chamber; 5 – deposited material; 6 – magnetic system for magnetron sputtering; 7 – vacuum pump; 8 – discharge voltage supply; 9 – ion beam; 10 – sputtered material; 11 – reaction gas; 12 – inert gas; 13 – cathode spot; 14 – evaporated material; 15 – accelerating voltage supply; 16 – hot cathode; 17 – crucible; 18 – electron beam*

**Table .1 – Characteristics of coatings obtained by the PVD method**

Coating	Color	HV*	Coefficient of friction on steel 45	Temperature of oxidation onset in air, °C
TiN	Golden	23...25	0.55	550...600
TiCN	Gray-blue	35...37	0.2	400
(Ti, Al)N	Purple-black	31...35	0.6	800...850
(Ti, Al)CN	Violet-red	35...37	0.25	500
CrN	Silver metallic	12...14	0.3	650
ZrN	Golden white	26...28	0.5	550
(Ti, Cr)N	Golden grey	18...20	0.5	700
(Ti, Al, Cr)N	Bronze	28...30	0.4	850...900

In The table shows the data recommended for the coating of cutting tools, since hardness depends on many factors (chemical composition of the coating, deposition modes, etc.) and can have different values.

To achieve CVD coatings, precise control of chemical reaction products and processes, the use of high-purity expensive chemical materials, etc. will be required.

PVD coatings are applied using arc or glow welding. Such Vid coverytia obespchivaet bogreater productivity and Not so sensitive To unknownhsignificant deviations of technological parameters. Therefore, the PVD method is finding increasing application.

The main operations of the standard technological process (STP) for applying coatings using the PVD method are as follows:[3]:

1. Placing plates in the chamber, heating and pumping out the vacuum chamber.
2. Preparation of plate surfaces by ion etching in a gas discharge.
3. Cleaning the surfaces of the plates by bombardment with metal ions and heating to operating temperatures.
4. Covering of loaded products.
5. Cooling and removing the plates from the chamber.
6. Quality control of the applied coating.

## Conclusion

Thus, applying wear-resistant coatings to a cutting tool is a complex task, an integral part of which is a high wear resistance index. This means that the applied coating must have a high "adhesion" strength to the tool substrate; be able to withstand thermal loads; have increased mechanical properties. In order for the coating to have good adhesion to the applied material, it is necessary to take into account the type of chemical bond, and it is also worth choosing a coating based on the area of application and the type of material being processed.

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