(Special Issue)

Asian Research Consortium

Asian Journal of Research in Social Sciences and Humanities
Vol. 10, No. 5, May 2020 (Special Issue), pp. 17-19.

ISSN 2249-7315
A Journal Indexed in Indian Citation Index

Asian Journal of Research in Social Sciences and Humanities

www.aijsh.com

Technology for Applying Plasma and Vacuum Coatings to the Surface

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Abstract

This article discusses the modern hardening technology of a metal cutting tool - PVD_process, as well as a new technology for finishing plasma hardening (FPU) by vacuum-free deposition of wear-resistant nanocoating based on carbide, nitride and silicon oxide.

Keywords: Wear-Resistant Coatings, Coating Methods, Improvement of Cutting Tool Characteristics.

Introduction

Vacuum-plasma coating methods in the industry are called PVD-method-application by condensation from the vapor (gas) phase (English. physical vapour deposition; abbreviated PVD) refers to a group of methods for spraying coatings (thin films) in a vacuum, in which the coating is obtained by direct condensation of the vapor of the applied material.

In physical vapour deposition (PVD) coating material passes from the solid state to the gas phase by evaporation under the influence of heat or in the spraying due to the kinetic energy of the collision of material particles. The energy, distribution, and density of the particle flow are determined by the application method, process parameters, and the shape of the particle source. PVD coating is carried out at temperatures up to 450°C, which practically does not impose restrictions on the materials used for coating. This is especially important when coating high-speed steel, since the process temperature does not exceed the tempering temperature of hardened steel

(about 550°C). PVD processes are carried out in a vacuum or in the atmosphere of the working gas at a sufficiently low pressure (about 10-2 mbar).

Sputtering can be diode or magnetron, with direct current or high frequency current, in the reaction gas medium or without it, with or without bias voltage, with additional modification of the magnetic field (unbalanced or with a closed field) or without it.

In the vast majority of cases, one of the three methods of ion deposition is used for coating the instrument. These include:

* Electron beam evaporation,

* Electric arc evaporation (CIB method),

* Sputtering (magnetron) by ion bombardment.

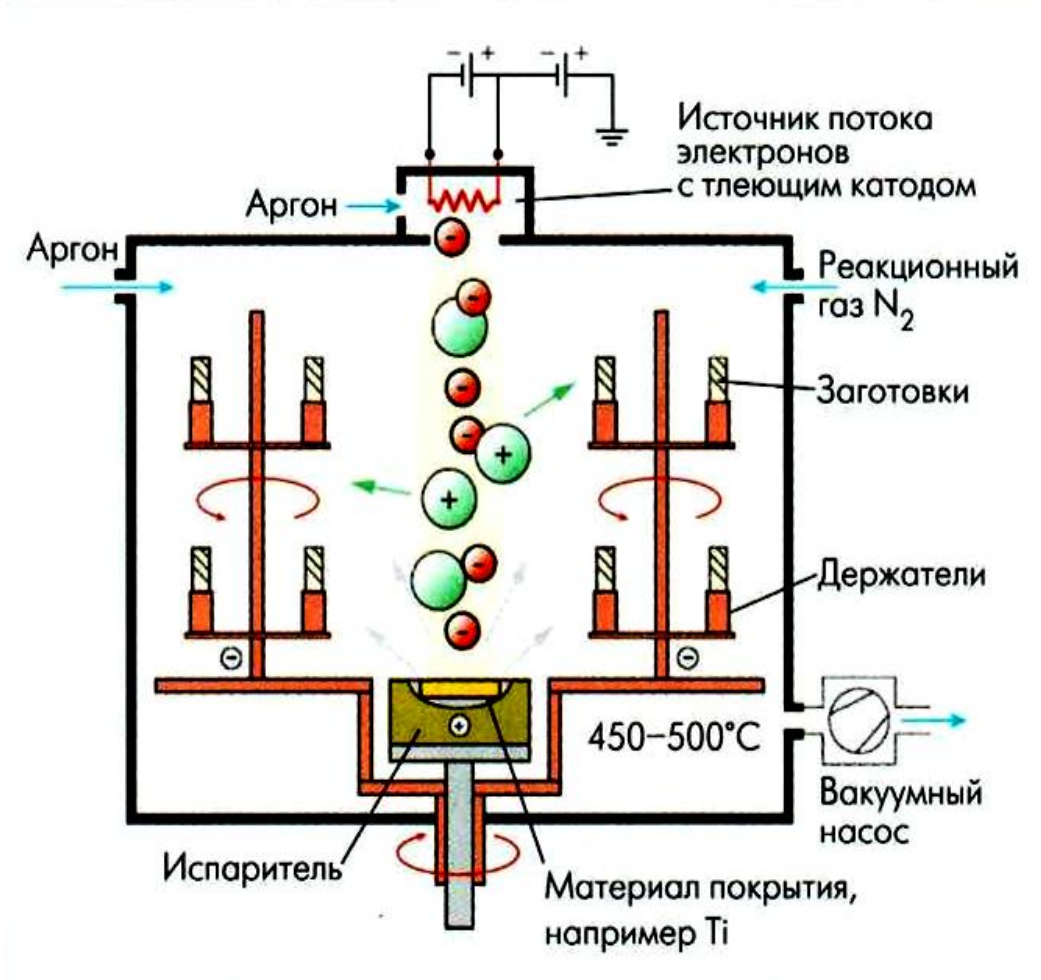

Figure 1. Method Evaporation Electron Beam

In installations using electron beam evaporation, a high voltage (1-10 kV) is applied to the cathode with a glow arc. As a result, a focused and accelerated electron beam (about 200 A) is created, which is directed to a target with a metal coating material (Fig. 1). the Target is installed in the center of a horizontally located boiler made of graphite, ceramics or copper.

Positive voltage is applied to the boiler. A negative voltage, called the bias voltage, is applied to the opposite stand with the covered tools. Positive ions of the vaporized substance (for example, titanium) react with the reaction gas (for example, nitrogen) and form a coating material (titanium nitride), which is deposited on the coated tool. The coating chamber is made of stainless steel with double walls with heating and cooling systems.

Conclusion

Based on the literature study on methods for applying wear-resistant coatings to cutting tools, it is shown that applying a wear-resistant coating to tool materials allows us to approach the creation of an "ideal" material that has high wear resistance in combination with sufficient strength and viscosity. It can meet the highest requirements for quality, performance and reliability.

Literature

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