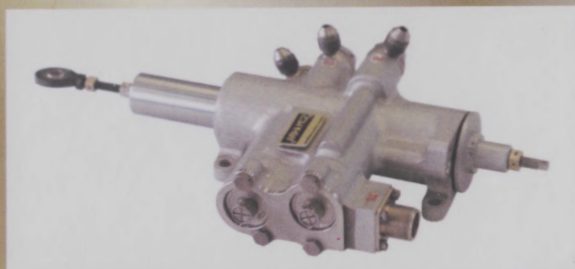
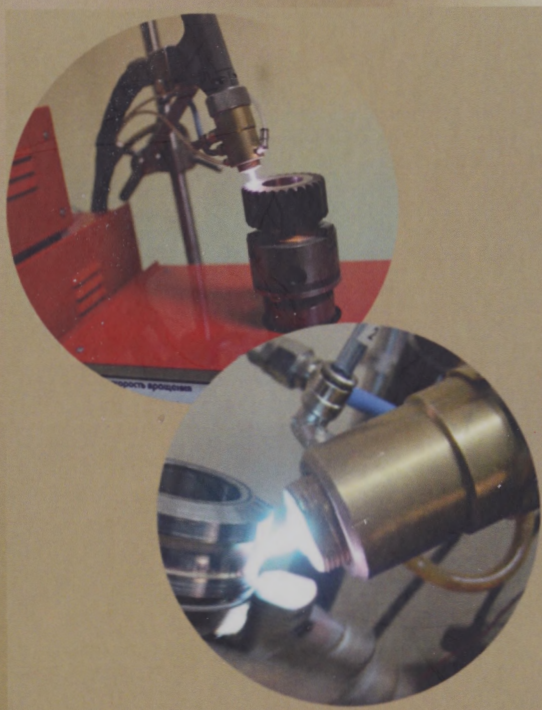


G. I. Kostyuk, V. V. Popov



NANOTECHNOLOGY IN AVIATION AND GENERAL MACHINE BUILDING INDUSTRY





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The future of the modern company is in the courage of the first step. And we therefore wend the way of search, approbation and application of new perspective business lines, new technologies, new equipment, new items for aviation and space, young and professional engineers, managers and designers.

FED JSC initiated the creation of the industrial park «Slobozhanshchina». One of its co-founders was the Scientific park «FED». The founders of the latter are FED JSC and the State enterprise «KhADB».



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On the basis of the analysis of the results of processing critical and complex parts of aggregates, difficult-to-process materials and the most commonly used types of processing have been selected: turning and milling with cutting tools with interchangeable inserts hardened by various methods.

The second section is devoted to the theory of hardening of radiation sources and parts by plasma-ion processing, where all the main sources and sinks of heat are taken into account. In addition, the crystallization energy and the influence of quantum-mechanical effects were taken into account in the theoretical determination of the thermophysical and thermomechanical characteristics of materials, as well as different speeds of heat propagation (from the speed of light to the speed of sound). Taking into account these effects, the boundaries of the adequacy of certain methods for finding the technological parameters for producing nanostructures are found.

A similar study was carried out for the case of the action of conventional pulsed lasers (operating time 10^{-7} - 10^{-4} s) and femtosecond pulsed lasers, where problems with different speeds of heat propagation from speeds equal to the speed of light to the speed of sound are also considered, the energy nanograin formation, and quantum-mechanical effects in the theoretical determination of the values of the thermophysical and thermomechanical characteristics of the X-ray material and parts. The adequacy of the model in determining the grain size is shown.

For the combined technology (Section 4) based on plasma-ion, ion-beam, electron-beam and laser processing, the possibility of implementing such a technology to obtain unique operability and efficiency of a cutting tool and resource of parts by creating hardened layers up to 1-2 mm is shown. A computational model of the performance of this technology is given, which also allows you to get the performance of each of the technologies considered.

Experimental studies of the physicomechanical characteristics of coatings and materials with coatings and nanostructured layers have been carried out. The decisive influence of grain size on them is shown.

The characteristics of the cutting tools were investigated: the efficiency of the forming of the part (the removed volume of material during the durability period), the resistance of radiation sources, and the processing productivity (Section 6). A significant effect of grain size in the coating and RI material on these values was found.

The seventh section is devoted to the creation of the concept and principles of designing the chemical composition and type of hardening in order to obtain maximum

performance and efficiency of shaping the surface of parts. It was experimentally shown that to obtain the most effective composition of the hard alloy, its hardening and taking into account the adhesive interaction of the material RI, coating and the processed material. For milling, successful types of modification of the RI material were obtained, and for turning based on the results of other authors, agreement with the theory was obtained.

In conclusion, practical recommendations on the use of materials from the monograph are given.

In applications for plasma-ion, ion-beam, and laser technologies, the results on the production of nanostructures on various X-ray materials (tool steels, high-speed steels, hard alloys, and polycrystalline superhard materials) are presented, which make it possible to evaluate the technological parameters of their formation.

Key words: nanotechnology, aggregate construction, effective surface shaping, design of cutting tools, milling, turning.

Fig. 371

Tab. 72

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