Chapter 31

UNIFORMITY OF SUPERHARD MATERIAL GRINDING POWDERS

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Abstract The potentialities and essence of the method of adhesion-magnetic sorting of grinding powders (grits) of superhard materials (SHM) are considered. This method is applied to increase the uniformity of SHM powders. The expediency of the application of the parameter of uniformity of SHM powders with respect to the basic characteristics of quality is stated. The increase of the efficiency of tools with SHM powders of higher uniformity is shown.

Keywords: Diamond, Cubic boron nitride (cBN), Strength, Thermal stability, Surface imperfection, Uniformity of the SHM powder.

1. INTRODUCTION

Variously produced grinding powders (grits) of superhard materials (SHM) are characterized by the mean values of strength, thermal stability, magnetic and electric properties, grit surface imperfection. However, these characteristics do not reflect the uniformity degree of the powder with respect to each of the above properties. Powders having similar mean values of the quality characteristics might essentially differ in the degree of uniformity.

Numerous investigations indicate clearly that the efficiency of the tool and the quality of the surfaces being machined increase proportionally to the increase of the uniformity of SHM powders with respect to one or several characteristics. Therefore, the necessity arises for the assessment of SHM powders by the uniformity of quality. This will stimulate the development of improved methods of the SHM sorting and yield of powders suitable for
more efficient tools. Methods of classification of diamond and cubic boron nitride grits by size, shape, magnetic and electric properties as well as by the surface imperfection have been developed at the Institute for Superhard Materials of the National Academy of Sciences of Ukraine.

According to [1, 2], surface defects of diamond crystals characterize the synthesis and recovery of diamonds from the synthesis product. The surface defects dictate the strength characteristics of the crystals. It is known that any surface of a solid possesses surface forces that can retain atoms, molecules or solid microparticles. The surface forces are used to fix solid microparticles with clearly defined magnetic properties on the diamond surface. The mass of adhered particles is proportional to the degree of the crystal surface imperfection [3]. As a result, a diamond crystal acquires magnetic properties. The difference in magnetic properties between crystals provides the basis for the separation of diamond particles in the magnetic field. On these principles the adhesion-magnetic sorting (AMS) of diamonds has been developed at the Institute for Superhard Materials [4].

In the present work, we have investigated the uniformity of the quality of commercial SHM powders. The efficiency of the increase in the uniformity of powders by a factor of 2.0–2.5 with the help of the adhesion-magnetic sorting is considered. The serviceability of the tool equipped with uniform SHM powders is increased by 20-25%.

2. EXPERIMENTAL

Experiments were carried out on grinding SHM powders (grits) with grit sizes ranging from 630/500 to 50/40 μm. The SHM powders produced by various companies of the world were investigated. The SHM powders were analyzed by the uniformity with respect to one or several basic characteristics (strength, thermostability, magnetic and electrical properties, surface imperfection, grain composition, magnetic susceptibility, etc.).

It is suggested to assess the powder uniformity by the concentration of grits whose characteristic in the given property corresponds to the mean (nominal) characteristic of the powder under study.

Here we discuss the uniformity of powders SHM with respect to the basic technical characteristics: strength (β₈), thermal stability (β₇) and grain structure (β₉).

We have studied the SHM grinding powders in the following sequence. At first, we have studied the basic quality characteristics of the powders as-received from the manufacturer. From the test reports, the