ON THE ETCHING OF FACES OF CUBIC BORON NITRIDE CRYSTALS

CRYSTALLOGRAPHY

1968

SovietRxiv

Abstract

Full Text

UDC 548.54.58+539.89

CRYSTALLOGRAPHY

N. E. FILONENKO, G. M. ZARETSKAYA, N. M. KAMENTSEVA, L. I. FELD' GUN

ON THE ETCHING OF FACES OF CUBIC BORON NITRIDE CRYSTALS

(Presented by Academician L. F. Vereshchagin, 5 V 1967)

The objects of the investigation were crystals of the new superhard compound cubic boron nitride, 0.3–0.6 mm in size, synthesized from compositions of the Mg—B—N system (1,2). The synthesis was carried out in a high-temperature, ultrahigh-pressure apparatus designed at the Institute of High Pressure Physics of the Academy of Sciences of the USSR.

Cubic boron nitride crystals were separated from the sinter by chemical treatment and examined under a binocular microscope. For the etching experiments, crystals with more perfect faceting were selected; they had 4–8 faces belonging to $\{111\}$ and $\{1\bar{1}1\}$ and, less often, $\{100\}$; the crystal faces were first photographed with an MIM-8m.

Etching of the face surfaces of cubic boron nitride crystals was carried out with molten sodium nitrate at 520–530° for 2 hours. The etched crystals were washed with distilled water and their faces were wiped with alcohol.

Examination with a metallographic microscope showed that, as a result of etching, growth forms in the form of positive trigonal pyramids appeared on the surfaces of the $\{111\}$ and $\{1\bar{1}1\}$ faces, and etch pits—negative trigonal, more rarely ditrigonal, pyramids truncated by a ribbed ditrigon (3). The positive trigonal pyramids, in turn, were often situated on flat growth layers that had the form of ribbed trigons (Figs. 1, 2). On the $\{111\}$ faces the etch figures are arranged parallel, and on the $\{1\bar{1}1\}$ faces antiparallel, to the edges (Figs. 1a, b, c, d; see insert facing p. 61). It should be noted here that etch pits in the form of negative ditrigonal pyramids were found only on the $\{111\}$ faces.

Comparison of microphotographs of the face surfaces before and after etching shows that the etch pits (negative trigonal and ditrigonal pyramids and ribbed trigons) are associated with defects of the crystal faces, i.e., with the places where dislocations emerge; this is especially clearly visible in Figs. 1a, b.

On the surface of the $\{100\}$ face, as a result of etching, ribbed growth forms appear, arranged antiparallel to $[1\bar{1}0]$, and etch pits in the form of negative

Figure 1

Figure 1: Figure 1

pyramids with a rectangular base (Fig. 1d).

Positive and negative etch figures are uniformly distributed over the surface of the face (Fig. 1a) or are gathered into groups, chains, whose arrangement is governed by the symmetry of the crystal (Figs. 1b, e).

On the $\{111\}$ face a ridge arranged parallel to an edge was found, formed by growth pyramids fused with one another (Fig. 1b); it apparently arose as a result of the healing of a crack in the crystal during growth (^{4}).

By means of etch figures it was possible to determine the twinned structure and mosaic character (Fig. 1e) of cubic boron nitride crystals, and to establish that the striation observed on the faces, in the form of mutually parallel di-

To the article by N. E. Filonenko, G. M. Zaretskaya et al., p. 88

Fig. 1. Faces of cubic boron nitride crystals, 150×.
a —$\{111\}$ face before etching; b —$\{11\bar{1}\}$ face after etching; v —$\{1\bar{1}1\}$ face before etching; g —$\{1\bar{1}1\}$ face after etching; d —$\{111\}$, $\{100\}$ faces after etching; e — $\{111\}$ face of mosaic structure.

of the ribs belongs to the growth layers of jointly growing individuals $\{1\bar{1}1\}$.

As a result of etching, intergrowths in the crystals and two-dimensional dendritic formations on the surface of their faces become more clearly manifested (Fig. 1e).

Thus, the experiments carried out established the configuration and arrangement of growth and etching figures on the faces of the simple forms $\{111\}$, $\{1\bar{1}1\}$, and $\{100\}$, characteristic of crystals of cubic boron nitride.

All-Union Scientific Research
Institute of Abrasives and Grinding

Received
27 IV 1967

CITED LITERATURE

[1] N. E. Filonenko, V. I. Ivanov, L. I. Feldgun, DAN, 164, No. 6 (1965).
[2] N. E. Filonenko, V. I. Ivanov, et al., Tr. Vsesoyuzn. n.-i. inst. abrazivov i shlifovaniya, No. 2 (1966).
[3] I. I. Shafranovskii, *Crystals of Minerals*, 1961.
[4] G. G. Lemlein, DAN, 89, No. 2 (1953).

Note: Figure translations are in progress. See original paper for figures.