EFFECT OF ALPHA-PARTICLES ON AMMONIUM DIHYDROGEN PHOSPHATE (ADP) SINGLE CRYSTALS

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The aim of this work was to reveal experimentally the effects of alpha-particles on ADP single crystals. The effects of nuclear radiation on crystals of the ADP type, which have ion-covalent bond, have not as yet been described in literature.

The ADP crystals satisfy one of the criteria for nuclear radiation detectors[1]: their specific resistance is above 2.10^3 Ωcm. It is not known whether these crystals satisfy the second criterium for alpha particles crystal detectors, i.e. that $(dE/dx)_c < 2$ MeV/mg/cm^2.

The faces (010) of pure ADP crystals were exposed in air to alpha particles of 5 MeV for 10 s to 15 min. The distance between the crystal faces and the radioactive source was 2 mm approximately. Immediately after the exposure or with a delay (up to 24 hours) the crystals were etched and then observed by means of an optical microscope in transition light (magnification up to 640x). The following etchants were used: pure acetic acid, acetic acid with BaJ_2 in various concentrations and saturated water solution of potassium acid phtalate. The etching time ranged from 3 s to 60 s. Under these conditions no distinction could be made between exposed and unexposed crystal faces when observed by means of the optical microscope. However, the differences were noticed when electronic microscope was used, and this is shown in Fig.1-5.

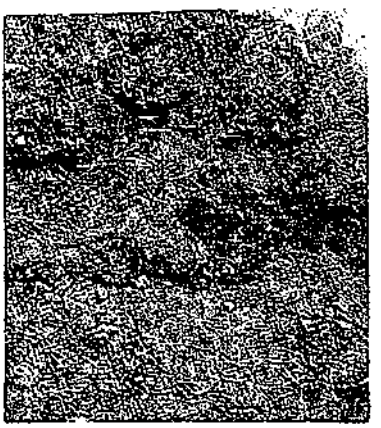

Fig. 1.

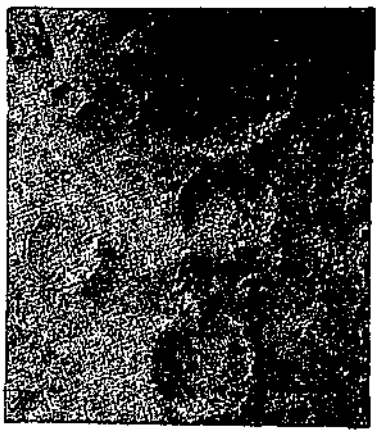

Fig. 2.

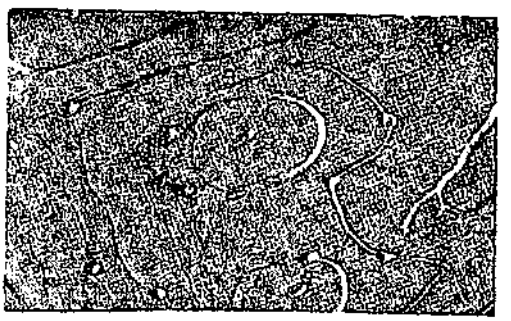

Fig. 3.

Fig. 4.

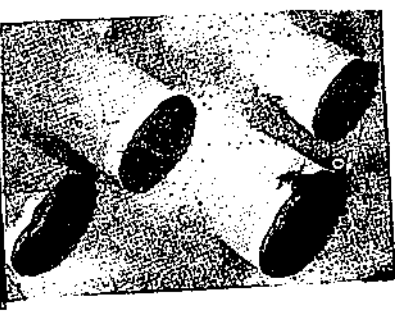

Fig. 5.

Crystal faces exposed to alpha particles for ±5 min can be seen in Fig.1 and 2 (total magnification 19500x) which were taken 1 hour and 24 hours respectively, after the exposure, without etching. Defects in the form of circular craters of 1 μ in diameter seem to have been caused by radiation damages. Comparing those two figures one can conclude that the observed defects change with time.

In Fig. 3. (total magnification 26000x) the unexposed crystal face (010) etched in the acetic acid with BaJ_2 for 20 s is shown.

In Fig.4. and 5. (total magnification 19500x) crystal faces etched 20 s and 60 s, respectively, immediately after the exposure, are shown. Comparing these two figures one can observe the development of the etch-pits (which correspond to radiation defects) when the etching time is prolonged. With the shorter etching time only a small number of pits is developed, while the most of them are in the first stage of development. When the etching time is prolonged, the development of etch pits is evident. It is characteristic that these pits are elliptical in shape (d∿1 μ) and oriented in one particular direction, i.e. they differ clearly from the dislocational pits of these crystals[2].

References:

(1) R.L.Fleisher et al., J.Appl.Phys, 36, 3645 (1965).
(2) V.A.Malešina, Kristalografija, 12, 523 (1967).