

SURFACE ADSORPTION OF  $\text{Cs}^{137}$  IONS ON QUARTZ CRYSTALS\*

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A preliminary investigation has been made of the adsorption of radioactive  $\text{Cs}^{137}$  ions on large quartz crystal faces from a solution of  $\text{Cs}^{137}\text{Cl}$ . This was done to determine if there is any relation between imperfections in quartz crystals caused by variations in crystal structure or in growth patterns and adsorption of ions on the crystal surface. If  $\text{Cs}^{137}$  is selectively adsorbed, this technique might be useful in detecting defective

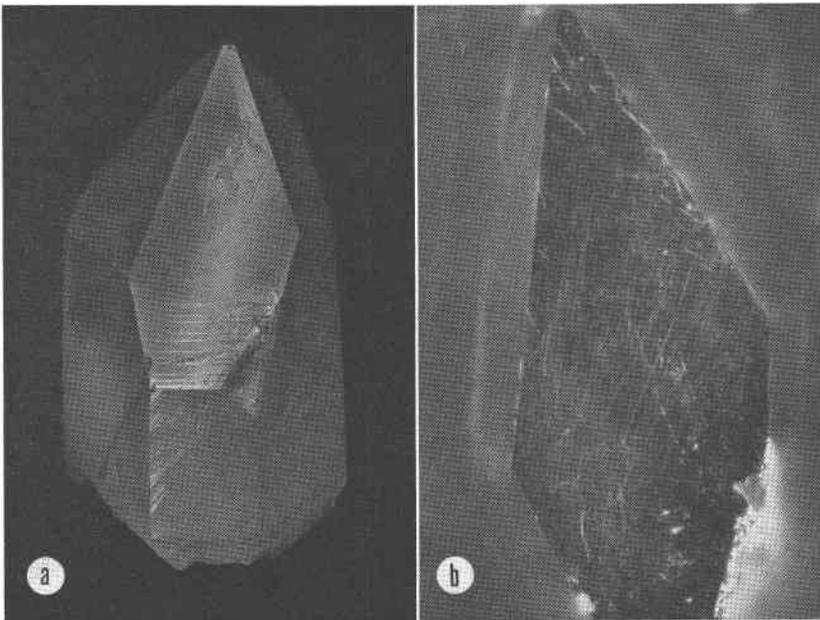


FIG. 1. (a) Natural quartz crystal in white light. (b) Autoradiograph caused by adsorbed  $\text{Cs}^{137}$ .

quartz crystals without destructive testing. Both natural and synthetic crystals were used in the investigation.

Each natural crystal was boiled in nitric acid for approximately 30 minutes to remove surface impurities. Both natural and synthetic crystals were then washed in benzene, alcohol, and de-ionized water. After drying, the crystals were immersed in  $\text{Cs}^{137}\text{Cl}$  solution, the radioactivity of which was about  $5 \mu\text{c}/\text{milliliter}$ , for periods ranging from 20 minutes to 1 hour.

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The synthetic crystals were immersed for the longer periods because adsorption was much less than with the natural crystals regardless of the time of contact with the solution. Autoradiographs made with the two types of commercially available  $\alpha$ -ray film gave good results. The films were kept in contact with the natural crystals for 18 hours and with most synthetic crystals for 120 hours. Normal photographic developing techniques were used.

Compared to the synthetic crystals, the natural crystals had many

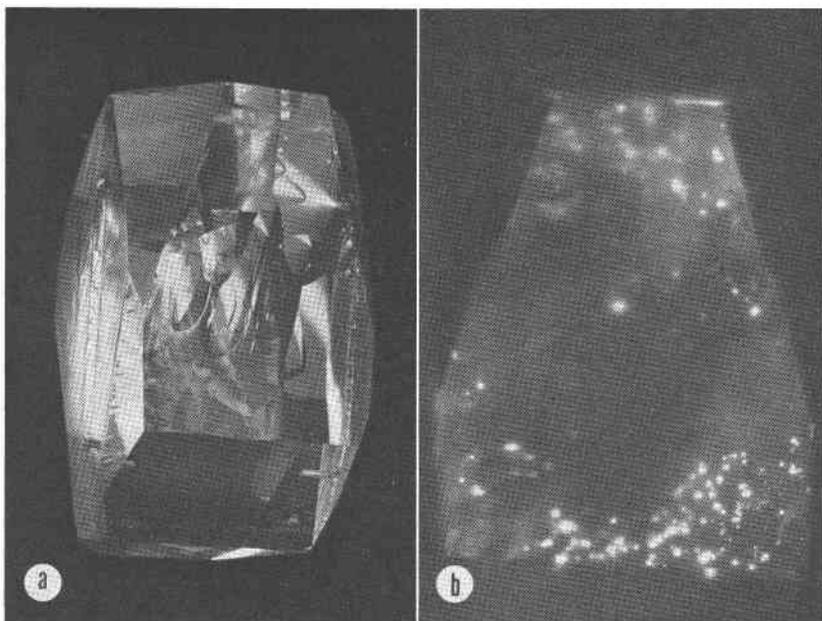


FIG. 2. (a) Synthetic quartz crystal in white light showing spiral-like growth patterns. (b) Autoradiograph showing spots at the apices of the growth patterns and acmite inclusions.

more surface irregularities, such as pits, which adsorbed the  $\text{Cs}^{137}$  ions to a greater extent than the regular crystal surfaces. These irregularities could easily be identified with a hand lens. On the other hand, certain markings were evident that could not be detected with the aid of a lens (see Fig. 1). The major and minor rhombohedral faces showed numerous adsorption lines that seemed to be surface manifestations of growth irregularities complicated by internal fractures and inclusions. These lines may be parallel to regular crystallographic directions, such as  $s$  or  $\alpha$  faces, not exhibited in the outer form of the crystal. It is interesting to note that, although there were visible patches of what appeared to be

electrical twinning and well-developed oscillatory combination lines, no selective adsorption was evident on these crystallographic structures.

As might be expected, the autoradiographs of the synthetic crystals were much clearer than those of the natural crystals. Regular growth lines were common and easily visible to the eye, but produced no effect on the film although surface pits and depressions produced numerous spots (see Fig. 2). Large numbers of surface lineations, which were common in the natural crystals, were not evident on autoradiographs of synthetic quartz. As was evident in natural crystals, electrical twinning did not produce a selective adsorption pattern. In some of the crystals it was evident that what appears to be spiral growth patterns can be emphasized by adsorption. In a number of cases strong adsorption spots on the film coincided with the centers of the spirals (see Fig. 2). This phenomenon seems to confirm the theory advanced by D. Hammond<sup>1</sup> of the Signal Corps Engineering Laboratories that the centers tend to be regular elongated cavities perpendicular to the direction of growth in a growth mechanism of this nature. One of the synthetic crystals also contained artificial inclusions of acmite. The crystal showed a large number of adsorption spots that appeared to coincide with the near-surface acmite inclusions.

This study was undertaken as part of a program conducted by the Geological Survey on behalf of the Division of Research of the Atomic Energy Commission.

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ADDITIONAL NOTE ON "BEYRICHITE, A DISCREDITED SPECIES"

In our recent brief note on Beyrichite (*Am. Mineral.*, **40**, 767-770 (1955)) we commented "Unquestionably Schneiderhöhn and Ramdohr are describing violarite." In a letter Professor Ramdohr very properly points out that this statement is obviously in error, violarite being isotropic, and the mineral referred to above being "strongly pleochroic," and further, that the substance in question was probably bismuthinite or emplectite. Both of these have been found by us (*loc. cit.* page 768) and Professor Ramdohr is correct in his identification and we wish to withdraw our erroneous statement concerning it.

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There will be a Symposium on Thermogravimetry and Differential Thermal Analysis at the spring (April) 1956 national meeting of the American Chemical Society in Dallas, Texas. It will be jointly sponsored by the Division of Analytical Chemistry and the Division of Physical and Inorganic Chemistry. The topics to be included relate to the applica-

<sup>1</sup> Oral communication, Frequency Control Review of Technical Progress, April 12-14, 1954. Asbury Park, N. J.

tions of techniques to investigations of reaction mechanisms, kinetic studies, the determination of physico-chemical and thermodynamic properties of inorganic and organic systems, as well as their analysis both qualitative and quantitative. Correspondence should be sent to Dr. Saul Gordon, Pyrotechnics Chemical Research Laboratory, Picatinny Arsenal, Dover, New Jersey.

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The American Iron and Steel Institute Regional Technical Meeting Award for 1954 was presented to Dean E. F. Osborn of The Pennsylvania State University, at the annual general meeting of the Institute in New York City on May 25. The medal was awarded to Dr. Osborn for his paper "Phase equilibrium studies in steel plant refractories systems" which was presented during the October Regional Technical Meeting held in Pittsburgh.

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Dr. G. W. Brindley of The Pennsylvania State University has been named professor of solid state technology and head of the newly named Department of Ceramic Technology, effective July 1. He has been research professor of mineral sciences since his appointment to the faculty of the college on July 1, 1953. Dr. Brindley has also been appointed associate editor of the *A.S.T.M. Index of X-Ray Diffraction Patterns for the Analysis of Materials*.

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A School for Advanced Study is to be established at the Massachusetts Institute of Technology. An opportunity will be afforded for advanced study beyond the level of the graduate school and the doctor's degree. Professor Martin Buerger has accepted the appointment as Director of the School for Advanced Study and also the appointment as Institute Professor.

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Word has been received of the death of Shukusuke Kôzu, professor emeritus of mineralogy and petrology of Tohoku University, Tokyo, Japan, on Feb. 11, 1955, at the age of 74 years.

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## CORRECTIONS

The paper on alluaudite (Nov.-Dec. 1955 issue) should be corrected as follows:

Page 1102—in line no. 16, the figures in columns 5 and 6 should be interchanged; and in line no. 23, the figure in column 4 should be 2.0967 (not 2.1361).

Page 1103—in line no. 24b, the figure in column 4 should be 1.9612 (not 2.0481); in line no. 26, the index on the right should be (312) [instead of (3 $\bar{1}$ 2)]; and in line no. 28, the spacing on the right should be 1.817 (not 1.813).

Page 1104—The dashed line on the right side of Fig. 2 is the trace of ( $\bar{1}$ 00).

Page 1108—line 10 from base: instead of "850/860°," read "higher."