The Increase of X-Ray Reflection from Quartz Due to a Strong Electric Field

When a strong electric field was applied to a thin quartz plate for a long time, it was found that the intensity of x-ray reflection increased very much even after the removal of the electric field. Crystal plates free from twin and about 1 mm in thickness were cut parallel to various net planes and etched slightly with HF solution. An electrostatic field of 10∼17 kv/mm was applied perpendicular to their surface. After the removal of the field, the intensity of x-ray reflection from an internal net plane was measured by the ionization spectrometer.

(1) The intensity of reflection increases at first with the length of time of application of the field, but reaches a saturation value after several hours of application.

(2) No difference is found whether the field is applied parallel or antiparallel to the electric polar axis.

(3) This effect is strongly structure sensitive,[1] but the general behavior is much the same for different crystallographic directions.

(4) The effect dies away very slowly after the removal of the field, and in some cases considerable increase in reflection is still observed after five or six days. However, at high temperatures or under the irradiation with x-rays or γ-rays, the decay is more rapid.

Further examinations are now in progress, and the definite conclusion concerning the origin of the effect must be postponed. But *there is no doubt that the increase of reflection is due to the decrease of x-ray extinction*[2] *as a result of the inhomogeneous strain.* Since the purely elastic stress shows no conceivable after-effect, and the present effect is easily destroyed by x-rays, it is natural to consider the effect to be electronic in its origin. A plausible explanation might be as follows: Electrons, after wandering through the crystal under the strong electric field, are trapped[3] by atoms at the lattice imperfection, and the stress thus produced may be the cause of inhomogeneous strain.

My sincere thanks are due to Professor S. Nishikawa for his continuous guidance and kind encouragement throughout this work.

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September 24, 1938.

[1] Smekal, *Handbuch der Physik*, 24/2.
[2] Ewald, *Handbuch der Physik*, 23/2, esp. §21 and p. 428.
[3] Gurney and Mott, Proc. Phys. Soc. **49**, 32 (1937).

Nuclear Isomerism in Element 43

We wish to report briefly an interesting case of isomerism which has appeared during an investigation of the short-lived radioactive isotopes of element 43. The irradiation of molybdenum with deuterons or slow neutrons produces a radioactive molybdenum isotope with a half-life of 65 hours which emits electrons with an upper energy limit of approximately 1 Mev. (This molybdenum activity has also been reported recently by Sagane, Kojima, Miyamoto and Ikawa.)[1] This molybdenum decays into a second activity which has a half-life of 6 hours and which emits only a line spectrum of electrons. Since the molybdenum emits electrons, the daughter activity must be ascribed to element 43; chemical identification has been carried out and has confirmed this identification of the 6-hour activity. Absorption measurements in aluminum and measurements with a magnetic spectrograph[2] indicate an energy for the electrons of about 110 kev. This line spectrum must be due to the conversion electrons of a gamma-ray of about 130 kev energy. The 6-hour activity also emits x-radiation and γ-radiation. The absorption of the x-rays in molybdenum, columbium and zirconium shows a discontinuity that is consistent with the $K\alpha$ line of element 43, which is to be expected on the basis of the interpretation given below.

The simplest and most reasonable explanation for these facts is the existence of an excited state in this isotope of element 43 which reverts to the ground state by the emission of conversion electrons and gamma-rays with a half-life of 6 hours. A line of conversion electrons corresponding to a similar transition seems to have been detected by Pontecorvo[3] during a study of the nuclear isomerism in rhodium. A more complete discussion and a description of the experiments will be published later in the *Physical Review*.

We wish to thank Professor E. O. Lawrence for the privilege of working with the cyclotron and for his interest in this problem.

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[1] Sagane, Kojima, Mijamoto and Ikawa, Phys. Rev. **54**, 542 (1938).
[2] Kalbfell, Phys. Rev. **54**, 543 (1938).
[3] Pontecorvo, Phys. Rev. **54**, 542 (1938).

The Helium-Deuteron and Deuteron-Deuteron Nuclear Reactions—Corrections

(1) In a recent letter to the *Physical Review*, A. J. Ruhling[1] has mentioned that long range protons had been reported[2] by us from the reaction

$$ {}_2He^3 + {}_1H^2 \rightarrow {}_2He^4 + {}_1H^1. \qquad (1) $$

I wish to point out that these observations turned out to be erroneous, and because of the presence on the target of a trace of boron as impurity. We have obtained no evidence so far that the reaction (1) does take place.

(2) R. D. Myers[3] quotes me as reporting[2] a spherical symmetry for the neutrons from the reaction

$$ {}_1H^2 + {}_1H^2 \rightarrow {}_2He^3 + {}_0n^1 \qquad (2) $$

in contradiction with observations of Kempton, Browne and Maasdorp.[4] This is not so.

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September 30, 1938.

[1] A. J. Ruhling, Phys. Rev. **54**, 308 (1938).
[2] Copenhagen Conference.
[3] R. D. Myers, Phys. Rev. **54**, 361 (1938).
[4] Kempton, Browne and Maasdorp, Proc. Roy. Soc. **A157**, 372 (1936).