

Regardless of this difference, however, it seems that Menzel's use of my experiments as observational proof of the points raised in his letter is a proper one. In fact, experiments at higher pressures and in smaller tubes have resulted in even higher relative intensities for the metastable transitions than those reported last spring. It is gratifying to see that my prediction of the possible astrophysical interest of these results has already been justified.

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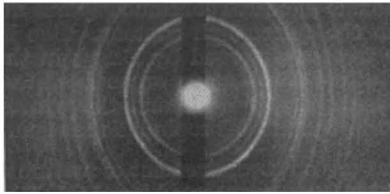
¹ Menzel, D. H., *NATURE*, 142, 644 (1938).

Conversion of Vitreous and Monoclinic (α) Selenium to the Hexagonal Modification

SELENIUM is known to exist in several stable allotropic modifications, of which the structures of the hexagonal and the monoclinic varieties (α and β) have been determined by Bradely¹ and Klug² respectively.

Prins and Dekeyser³ have investigated the gradual conversion of vitreous or amorphous selenium into the hexagonal variety at high temperatures and have also studied the influence of tension on this conversion. From their experiments they concluded that:

(a) The transformation of vitreous selenium into the hexagonal variety may take place at as low a temperature as 60° C., if a thread of vitreous selenium is kept under tension at that temperature.



(b) In the absence of tension, the crystallization does not take place below 73° C. The tension, therefore, helps the devitrification of vitreous selenium; and the fact that the degree of crystallization is most marked in the surface layers of a heated selenium stick and gradually becomes less in the deeper layers has also been suggested by them as due to the presence of mechanical stress, already present in the surface layers owing to the 'quenching' method of its preparation.

In the course of our investigations on selenium, we have obtained results which in many respects deviate from those of the previous authors. We find that, if thoroughly powdered specimens of vitreous selenium be maintained at a temperature even as low as 43° C., devitrification of the specimen sets in and gradually progresses with the period of heating, and after a considerable period, say about two weeks, a complete transformation into the hexagonal variety is clearly indicated by the appearance of only sharp diffraction rings on a clear background in its X-ray powder diagram. The powder-pattern obtained in this final stage is reproduced in the accompanying figure (taken with a hemicylindrical camera).

In the experiment mentioned above, we used powdered sticks of vitreous selenium; the diffracting specimen evidently consisted mostly of particles lying in the deeper layers or in the body of the sticks,

where the material is supposed to be free from any mechanical stress. Thus the experiment shows that even in the absence of tension, crystallization of vitreous selenium is possible at 43° C., if not at still lower temperatures. Insufficient period of heating the specimen is undoubtedly the cause of failure of the previous authors³ to detect the crystallization, which is extremely slow at lower temperatures.

In the case of monoclinic (α) selenium, we also find that the transformation into the hexagonal variety is quite rapid at 100° C. and may be detected after 24 hours of heating, whereas the same process is so slowed down at 80° C. that it cannot be detected before several days have passed.

Experiments are in progress to determine the lowest temperature at which these transformations take place. We are of opinion that in every case of monotropic structural transformation there is a critical temperature, below which the transformation in question cannot take place. At this temperature the molecules of the substance acquire the mobility which is required for their correct marshalling in the new structure.

A rise of temperature in all these cases increases the time-rate of conversion and thus minimizes the time required for the complete conversion of the whole specimen. Another example of this type of monotropic change which has been thoroughly studied by one of us⁴ is the conversion of S_{ω} or white sulphur into S_{α} or orthorhombic sulphur. Here both S_{ω} and S_{α} are the two different crystalline phases of sulphur.

Results of the investigation on selenium will be published in more detail in the *Indian Journal of Physics*.

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¹ Bradely, *Phil. Mag.*, 48 (1924).

² Klug, *Z. Krist.*, 88 (1934).

³ Prins and Dekeyser, *Physica*, 4 (1937).

⁴ Das, *Ind. J. Phys.*, 12 (1938).

Spectrum of Potassium Deuteride

A PRACTICALLY uncontaminated KD spectrum was obtained in an arc between potassium (negative) and nickel (positive) electrodes burning in a deuterium atmosphere of 50–30 cm. mercury pressure, and was photographed in the first order of a 15-ft. grating spectrograph having a dispersion of 3.7 Å. per mm.

In the strongest part of the many-lined spectrum between 4300 Å. and 5100 Å., the $v'' = 0$ progression bands $7 \rightarrow 0$, $8 \rightarrow 0$. . . $20 \rightarrow 0$ of the KD ${}^1\Sigma \rightarrow {}^1\Sigma$ system were found and analysed. At this dispersion, overlapped lines are still numerous and reach up to half the number of lines (60–80) in each band.

The rotational functions of both upper and lower states are anomalous in having a maximum in $\Delta_2 T_r / 4J + 2$ at about $J = 20$, and $T_r(v, J)$ must be expressed by terms with positive D_v , negative F_v , etc. However, this point should be examined with a larger dispersion, and preliminary values of rotational constants were calculated according to the usual three-term formula adjusted to the $J > 20$ regions. B_v^0 can be given by $B_v^0 = 0.673_7 + 0.00391(v' + 1/2) - 0.000281(v' + 1/2)^2$ within ± 0.005 , $D_v^0 = -1.4 \times 10^{-5}$, and $B_v^0 = 1.641$, $D_v^0 = -1.8 \times 10^{-5}$.