β-Radioactivities of Rhenium

On bombarding rhenium with slow neutrons, Fermi and his co-workers[1] found a β-activity with half-life 20 hours, and Kurtschatow and his collaborators[2] obtained 20-hour and 85-hour activities. Pool, Cork and Thornton[3] found that the bombardment of rhenium gives rise to an 18-hour period, which they ascribed to Re^{186} obtained through neutron loss Re^{187} $(n,2n)$ Re^{186}.

We repeated the experiments by bombarding metallic rhenium with slow neutrons (through paraffin) from Be+D and fast neutrons from Li+D (up to about 17 Mev) produced in the cyclotron in our laboratory. In both cases we obtained activities having half-lives 16 hours and 90 hours, respectively, which correspond to the two periods above-mentioned. The ratio, however, of the initial intensities corrected for the infinite activation time, or $R = I(90\text{ hr.})/I(16\text{ hr.})$, was 1.2 for slow neutrons from Be+D and 17 for fast neutrons from Li+D.

Now rhenium has only two isotopes Re^{185} and Re^{187}. From the above large change in the ratio of the intensities for two cases, it seems therefore more probable, contrary to Pool, Cork and Thornton, to ascribe the 16-hour period to Re^{188} and the 90-hour activity to Re^{186}.

Energy spectra of these two activities were studied with the Wilson cloud chamber method. Both emit electrons and the energy upper limits reduced from K-U plots were 1.2 Mev for Re^{186} (90 hr.) and 2.5 Mev for Re^{188} (16 hr.).

A more detailed report will be published shortly in the Scientific Papers of the Institute of Physical and Chemical Research.

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[1] E. Fermi *et al.*, Proc. Roy. Soc. **149**, 522 (1935).
[2] B. Kurtschatow *et al.*, Physik. Zeits. Sowjetunion **8**, 589 (1935).
[3] M. L. Pool, J. M. Cork and R. L. Thornton, Phys. Rev. **52**, 239 (1937).

The Effect of Hydroxyl Ion Concentration (or of *p*H) on the Film Potentials of Multilayers

When an X multilayer of calcium stearate is built upon a subphase of metal, the resultant increment of film potential may be as high as 100 Mv per layer if the aqueous subsolution upon which the monolayer is spread initially is made alkaline to a *p*H of 9.4 by the addition of ammonia.[1] With potassium ions instead of ammonium ions the film potentials are lower, and of the order of 60 Mv per layer.[2]

An experiment carried out by us in March, 1938, gave evidence of the effect of *p*H upon film potentials and suggested the more definite work described in this letter. In the earlier experiment the *p*H of the aqueous subsolution was brought to 9.4 by the use of ammonia, but this is volatile. As long as the *p*H was close to 9.4, the increment of potential per layer due to the taking up of positive ions by the outside of the multilayer was of the order of 85 Mv, but when the *p*H fell below this, the film potential also dropped, and in some instances to zero. If after such a drop the *p*H was restored to 9.4, the increment of the film potential was immediately restored to a large value, as for example 300 Mv per layer. (The increase in magnitude above 100 Mv per layer is due to an increased thickness of the multilayer underneath.)

In order to secure additional and conclusive evidence it seemed that X films should be built at a low *p*H if possible. An interruption in the work gave us the advantage that during this interval Goranson and Zisman discovered how to produce X films on ebonite at a *p*H of 6.3, and it seemed that their technique could be used for deposition upon a metal.

In our work the speed of dipping was 5 cm per minute, with an interval of 30 seconds between each down and up trip but only a short interval when the slide was in the air.

Several trends are evident in Fig. 1.

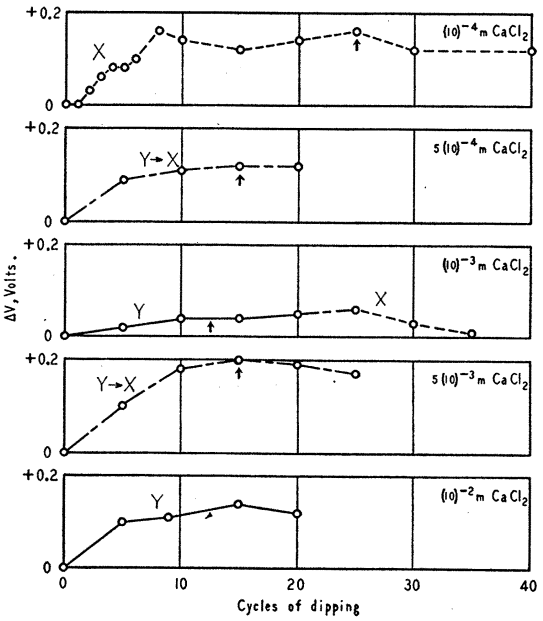

FIG. 1. Variation of film potentials with number of layers. ———— Y deposition; — — — — Y changing to X deposition; — — — — — X deposition. The arrow marks the optical thickness at which the film gave an orange interference color with the electric vector of polarized white light perpendicular to the plane of incidence and with the angle of incidence about 80°.

(1) The film potentials of the calcium stearate X multilayers on gold at *p*H 6.3 do not increase linearly with the number of layers, but reach a value of about +0.1 or +0.2 volt in a few layers, as with the Y type of deposition. After this the increment per X layer is almost zero (±). For similar X layers on ebonite at this *p*H, Goranson and Zisman report a charge which increases rapidly with the number of layers.

(2) At a *p*H of 6.3, $(10)^{-4}$m $CaCl_2$ gives the X type of deposition; $(10)^{-2}$m $CaCl_2$ gives the Y type of deposition. An intermediate molarity gives a deposition which may start with the Y type and change over to the X type. The contact angle changes continuously from about 0° to about 90° as the type of deposition changes from Y to X.