

Induced Radioactivity of Mercury

By means of a sensitive tube counter outfit in which the effects of penetrating cosmic radiation are partially compensated<sup>1</sup>, it was found that mercury (as HgO) could be activated by neutron bombardment, the active product decaying with a period of  $40 \pm 5$  hours. The irradiated mercury oxide was dissolved in nitric acid and the mercury passed through a series of different precipitations. It was also mixed with inactive gold and platinum compounds, and the metals then carefully separated. In every case the activity followed the mercury fraction and is, consequently, probably due to the isotope  $^{205}\text{Hg}$ .

The nature of the emitted particles has not been investigated. If they are negative electrons, as will probably be the case, the active mercury isotope is transformed into the stable isotope of thallium  $^{205}\text{Tl}$ . The activity is weak (the isotope  $^{204}\text{Hg}$  being present in an amount of only 6.85 per cent of the element); the number of impulses per minute from 0.7 gm. of HgO which had been irradiated four days with a radon-beryllium source (initial activity 100 millicuries) was about equal to the natural activity of 0.006 gm.  $\text{Sm}_2\text{O}_3$  observed under the same conditions.

Some other hitherto unknown active isotopes have been observed and will be described later. From a chemical and biological point of view, it is of special interest that an active isotope of sulphur, decaying with a period of more than two months, can be isolated from carbon tetrachloride which has been irradiated with neutrons.

No measurable activity could be detected after irradiation of bismuth ( $\text{Bi}_2\text{O}_3$ ).

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<sup>1</sup> *Z. Phys.*, **98**, 597 (1936).

Oxide Films of Some Alloys

By means of cathode ray diffraction, we have already shown that, at high temperatures, a thin film of  $\gamma\text{-Al}_2\text{O}_3$  is superficially formed on aluminium bronzes containing more than 3 per cent of aluminium,

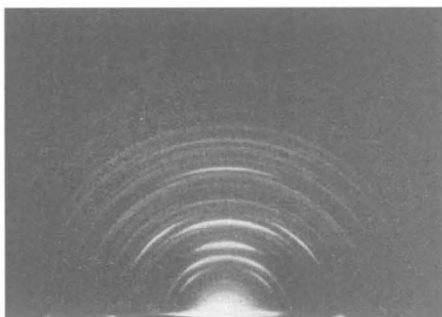


FIG. 1. Diffraction pattern of  $\text{NiCr}_2\text{O}_4$  on nichrome.

and a ZnO-film on brass (Zn 30 per cent, Cu 70 per cent)<sup>1</sup>. These films protect the alloys from further oxidation.

Copper-beryllium alloys also possess a remarkable non-oxidising property at high temperatures. According to our electron diffraction studies, this property

seems to be due to a film of BeO (hexagonal,  $a_0 = 2.70 \text{ \AA}$ ,  $c_0 = 4.39 \text{ \AA}$ ), which is formed when the beryllium content exceeds the small quantity of 1 per cent. It is a striking fact that no rings of copper oxide are found in the diffraction pattern when alloys containing such small percentage of beryllium are heated at a red heat.

Nichrome (Ni 80, Cr 20 per cent) is one of the most prominent of non-oxidising alloys. From the heated surface of this alloy we obtained the diffraction pattern due to  $\text{NiCr}_2\text{O}_4$  or  $\text{NiO} \cdot \text{Cr}_2\text{O}_3$  (cubic,  $a_0 = 8.30 \text{ \AA}$ ) (Fig. 1). The marked non-oxidising property of this alloy may be explained by the formation of this oxide film.

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Spin Coupling in the  $^3\Sigma$ -State of Phosphorus Deuteride

KRAMERS<sup>1</sup> has shown how the fine structure of  $^3\Sigma$  molecular energy levels, which is not completely accounted for on Hund's theory by the interaction of the resultant electron spin with the magnetic field arising from the rotation of the nuclei, may be explained by considering the mutual interaction of the individual electron spins.

Interaction of the resultant electron spin with the rotating molecule splits each rotational level into three components given by the term :

$$f(K, J - K) = \frac{1}{2} \gamma [J(J + 1) - K(K + 1) - S(S + 1)]$$

where  $J = K, K \pm 1$ ;  $S = 1$ ;  $K = 0, 1, 2 \dots$ . The mutual interaction of the spins gives to these components the additional energies :

$$f_{K+1} = \frac{2\varepsilon K}{2K + 3}; \quad f_K = 2\varepsilon; \quad f_{K-1} = -\frac{2\varepsilon(K + 1)}{2K - 1}$$

Since the publication of Kramers's work, which considered only the  $\text{O}_2$  molecule, the constants  $\gamma$  and  $\varepsilon$  have been evaluated for the following molecules :

| Molecule      | $\text{O}_2$ | $\text{N}_2$ | PH      | $\text{OH}^+$ |
|---------------|--------------|--------------|---------|---------------|
| $\gamma$      | - 0.025      | - 0.003      | - 0.072 | - 0.132       |
| $\varepsilon$ | + 0.242      | - 0.433      | + 0.713 | + 0.76        |

We have now succeeded in photographing on the 4th order of the 10-ft. concave grating the band of phosphorus deuteride corresponding to that of phosphorus hydride, and have obtained from it the values  $\gamma = -0.041$ ,  $\varepsilon = +0.74$ . The changes produced in the values of the constants on substitution of the isotope of hydrogen are in agreement with the explanation given above;  $\gamma$ , which involves the rotation of the nuclei, is reduced to little more than half its former value, corresponding to the increase in the moment of inertia, while  $\varepsilon$  is only slightly changed. A full account of the investigation will be published shortly.

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<sup>1</sup> *Z. Phys.*, **53**, 422 (1929).