

NUCLEAR SPIN OF RHODIUM.

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RHODIUM, according to Aston,¹ consists of a single isotope of mass 103. Fermi² has observed the presence of two periods of artificial radio-active decay for this element; on irradiation with slow neutrons, rhodium emits β -rays of two periods with half-lives 44 secs., and 3.9 mins. Suspecting that the double period might arise from an undiscovered additional isotope, Sampson and Bleakney³ have recently submitted the element to a mass spectrographic study with a new ion source. They have thus established the existence of Rh 101 present to one part in 1300 of Rh 103. In study of the hyperfine structure of rhodium lines, however, the rôle of Rh 103 only need be considered as the other isotope Rh 101 has relatively a negligibly small abundance. The object of the present investigation is to determine from hyperfine structure data of the arc lines of rhodium the nuclear spin of Rh 103. White⁴ has given it as $5/2$; this result has presumably arisen from a possible confusion between rhenium and rhodium, which exists in Gibbs' Bibliography of Line Spectra of the Elements.⁵ The hyperfine structure of the rhodium lines has therefore been investigated here with the conclusion that the isotope Rh 103 has a nuclear spin of $\frac{1}{2}$ with a small positive magnetic moment.

The rhodium arc lines were obtained from a water-cooled hollow cathode source previously described.⁶ The lines involving the deepest levels $4d^8 5s \ ^4F_{4\frac{1}{2}, 3\frac{1}{2}}$ were examined for structure with a quartz Lummer-Gehrcke plate 3.45 mm. thick and 20 cm. long. The following arc lines with the common level $^4F_{3\frac{1}{2}}$ were observed to be single:

¹ Aston, *Proc. Roy. Soc.*, 1935, 149, 397.

² Fermi, *ibid.*, 1934, 146, 483.

³ Sampson and Bleakney, *Phys. Rev.*, 1936, 50, 732.

⁴ White, *Introduction to Atomic Spectra*, 1934, p. 372.

⁵ Gibbs, *Rev. Mod. Phys.*, 1932, 4, 399.

⁶ For experimental details *vide* Venkatesachar and Sibaiya, *Proc. Ind. Acad. Sci.*, 1935, 1, 955.

λ in \AA	Classification ⁷
3528.0 ..	$4d^8 5s \ ^4F_{3\frac{1}{2}} - 4d^8 5p \ ^4F^0_{3\frac{1}{2}}$
3583.1 ..	$4d^8 5s \ ^4F_{3\frac{1}{2}} - 4d^8 5p \ ^4F^0_{4\frac{1}{2}}$
3658.0 ..	$4d^8 5s \ ^4F_{3\frac{1}{2}} - 4d^8 5p \ ^4D^0_{2\frac{1}{2}}$
3701.2 ..	$4d^8 5s \ ^4F_{3\frac{1}{2}} - 4d^8 5p \ ^4G^0_{4\frac{1}{2}}$

Two arc lines having a common level in the ground term $^4F_{4\frac{1}{2}}$ show a doublet structure :

λ in \AA	Classification ⁷	Structure in cm.^{-1}
3434.9 ..	$4d^8 5s \ ^4F_{4\frac{1}{2}} - 4d^8 5p \ ^4G^0_{5\frac{1}{2}}$	0.000(11), + 0.058(9)
3692.4 .	$4d^8 5s \ ^4F_{4\frac{1}{2}} - 4d^8 5p \ ^4D^0_{3\frac{1}{2}}$	0.000(11), + 0.058(9)

The above doublet structure does not arise from self-reversal because the resonance lines of copper have been observed unreversed under the same conditions of discharge ; besides this the melting and boiling points of rhodium are higher than those of copper. Assuming that the upper levels are negligibly split, the observed structure of the last two lines can be explained as arising from a splitting of the ground term $^4F_{4\frac{1}{2}}$ when a nuclear spin of $\frac{1}{2}$ is ascribed to Rh 103 (*vide* Fig. 1).

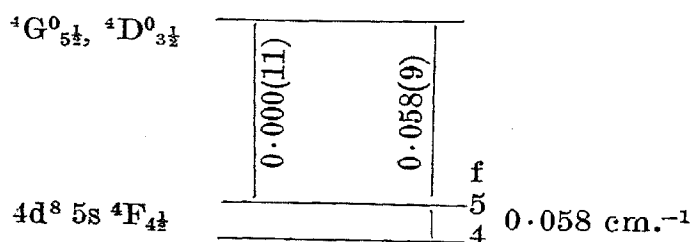


FIG. 1.

A microphotograph of $\lambda 3434.9 \text{\AA}$ (Fig. 2)* shows its two components with their relative intensities. The smallness of the hyperfine structure interval

⁷ Meggers and Laporte, *Phys. Rev.*, 1926, 28, 654 ; also Sommer, *Zeits. f. Physik.*, 1927, 45, 147.

* The microphotograph was taken by me at the Indian Institute of Science with the kind permission of the Director, Sir C. V. Raman.

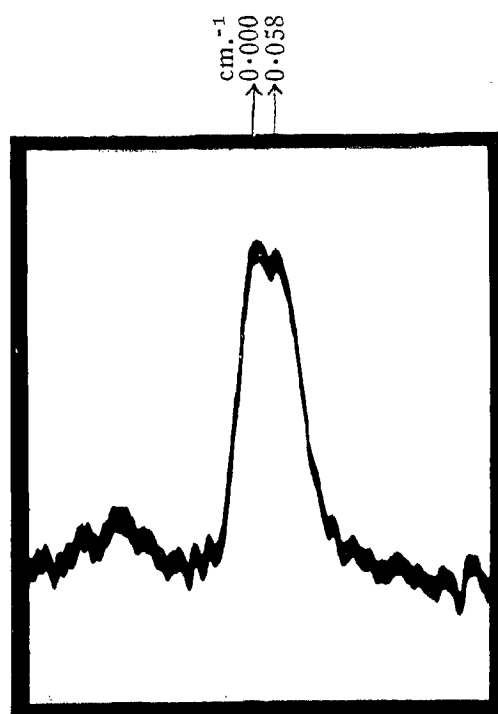


FIG. 2. Microphotograph of the Structure Pattern of RhI λ 3434.9 \AA .