THE THERMIONIC WORK FUNCTION OF GRAPHITE—III

by S. B. L. MATHUR, *Physics Department, Lucknow University.*

(Communicated by Dr. B. N. Srivastava, F.N.I.)

(*Received September 8; read October 4, 1952.*)

INTRODUCTION.

A. S. Bhatnagar (1944) determined the value of the electron work function of graphite by heating a cylinder of graphite closed on all sides except for a small hole at one end to different high temperatures in vacuum and measuring the rate of flow of electrons effusing out of the hole by means of a galvanometer attached to a Faraday Cylinder which collected the electrons.

The work under report is an extension of the investigations of the thermionic constants of molybdenum (Mathur, 1953) and of iron (Mathur, 1953). In principle the method is the same as that of Bhatnagar, but in the matter of design, it is an improvement on the latter's work, as the cylinder of graphite with the effusion hole at one end was heated by being enclosed in an outer furnace tube of graphite and not by an electric current flowing directly through the experimental tube, as in Bhatnagar's experiment. This enabled the graphite cylinder under investigation to acquire a much more uniform temperature than could have been possible by direct electrical heating. All the details of the experiment were the same as those on molybdenum (Mathur, 1953).

RESULTS.

From the readings of the electron effusion current at different temperatures, the values of $\log_{10} i_0/T^2$ were calculated and plotted against the corresponding values of $1/T$ as shown in the accompanying figure. The numbers 1, 2. . . . 5, indicated against the various points on the graph show the number of the day on which the data were collected. It will be seen that the same straight line fits all the points showing that the data were reproducible.

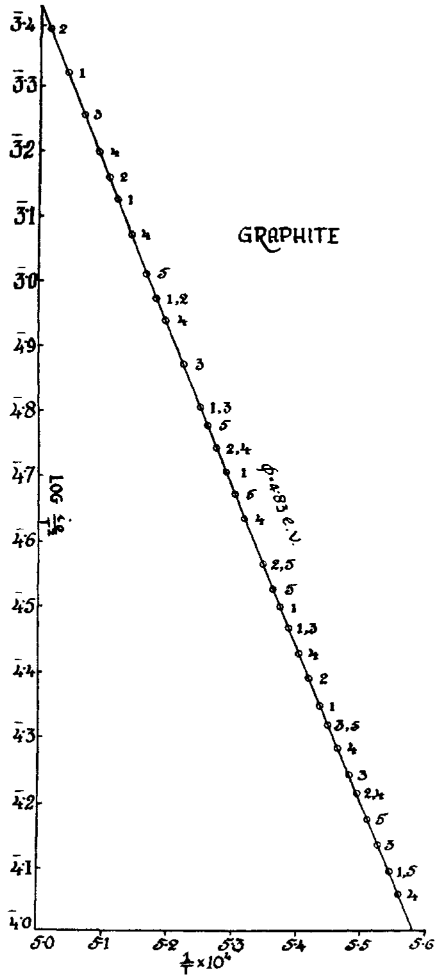
From the slope of the line in the figure, the value of the electron work function of graphite comes out to be 4·83 e.v.

Substituting the above value of the work function in the equation (Mathur, 1953)

$$\log_{10} \frac{i_0}{T^2} = -\frac{\phi}{kT} \log_{10} e + \log_{10} A_0 \frac{Sr^2}{r^2+d^2},$$

and taking r, the radius of the diaphragm of the Faraday cylinder to be 0·426 cms., d, the distance between the diaphragm and the effusion hole to be 1·3 cms., and the radius of the effusion hole to be 0·0502 cms., the average of the various values of the constant A_0 was found to be 170 amp./cm.^{2} deg.^{2}

The following table summarises the thermionic data obtained by the more recent workers (Roy, 1926; Reiman, 1938; Bhatnagar, 1944; Braun and Busch, 1947; Mathur, 1953) on graphite. The values obtained in the present investigations also are given.



Investigators.	Year.	Method.	Work function in e.v.	A in amp./cm.² deg.²
1. Roy	1926	Photoelectric ..	4·82	..
2. Reiman ..	1938	Thermionic ..	4·84	30
3. Bhatnagar ..	1944	Effusion ..	4·84	..
4. Braun and Busch ..	1947	Thermionic ..	4·39	15
5. Mathur ..	1953	Effusion ..	4·83	170

ACKNOWLEDGEMENTS.

The author wishes to thank Prof. Sir K. S. Krishnan, F.R.S., for his guidance, Dr. B. N. Srivastava for much help, the Physics Department of the Allahabad University for the facilities of the laboratory in which the investigations were carried out in 1945-46, and, finally, the Council of Scientific and Industrial Research, India, for the appointment of the author as a research assistant to Prof. K. S. Krishnan.

Summary.

From the rate of effusion of electrons through a small hole in an otherwise closed cylinder of graphite indirectly heated in vacuum to various high temperatures, the thermionic constants of graphite have been determined. This investigation is a continuation of the method adopted by the author for work on molybdenum and iron. The value of the electron work function for graphite was found to be 4·83 e.v. and that of the constant A_0 was 170 amp./cm.^{2} deg.^{2}

References.

Bhatnagar, A. S. (1944). The Thermionic Work Function of Graphite. *Proc. Nat. Acad. Sci., India*, **14** (A), 5–11.

Braun, A. and Busch, G. (1947). Measurement of the electron emission from Carbon, Silicon and Silicon Carbide. *Helv. Phy. Acat.*, **20** (No. 1), 33–36.

Mathur, S. B. L. (1953). On a new method of determining the Thermionic Constants of Molybdenum. *Proc. Nat. Inst. Sci., India*, **19**, 153–164.

——— (1953). The Thermionic Work Function of Iron. *Proc. Nat. Inst. Sci., India*, **19**, 165–168.

Reiman, A. L. (1938). Thermionic Emission from Graphite. *Proc. Phys. Soc.*, **50**, 496–500.

Roy, S. C. (1926). Total Photoelectric Emission from metals as a function of the exciting radiation. *Proc. Roy. Soc.*, **112** (A), 599–630.

Issued March 25, 1953.