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SOME MEASUREMENTS WITH THE MICROPYROMETER.[1]

BY G. K. BURGESS AND R. G. WALTENBERG.

THE micropyrometer[2] has been used for the exact determination of the melting points of the chemical elements of atomic weight from 48 to 59, using as calibration points Ni = 1,452, Pd = 1,549 and Pt = 1,755, and the calibration equation of the pyrometer lamp $\log c = a + b \log T$, where c = current and T = absolute temperature. Using samples from several sources, the following melting points were obtained in hydrogen: Cobalt, 1,478; iron (5 samples of which 3 electrolytic), 1,533; manganese, 1,260; chromium 1,520; vanadium, 1,720; and titanium, 1,795. Ni, Fe and Co were also checked in an Arsem furnace.

The melting points of Zr, Be, Y, Er, B, Th, U, etc., are under investigation, as also the measurement of the emissivities of the various elements by means of the micropyrometer. Alloying is shown not to affect the melting points of the metals except when there is chemical combination. Day and Sosman's values for the melting points of the salts: diopside, 1,391, and anorthite, 1,549, were also confirmed. Several hundred steels are also being examined. Some of the advantages of use of the micropyrometer are (1) small quantity of material required (0.001 mgr.); (2) speed, five to twenty minutes for a melting point determination at 1,700; (3) easy calibration, two points only required; (4) great range available, 600° to 3000° C.

SOME CHARACTERISTICS OF TOTAL RADIATION PYROMETERS.[1]

BY G. K. BURGESS AND P. D. FOOTE.

ALTHOUGH the relation between the energy emitted by a black body and its temperature follows the law $J = \sigma T^4$, since the fraction absorbed by the radiation pyrometer is in general not a constant factor for all temperatures but rather of the form $f(T)$ we have for this type of pyrometer an equation

[1] Abstract of a paper presented at the Washington meeting of the Physical Society, April 25 and 26, 1913.

[2] "A Micropyrometer," G. K. Burgess, Bull. Bureau of Standards, *9*, 475, 1913; Jl. Wash-Acad., *3*, 7, 1913.

which does not necessarily follow the fourth power law but has the form $E=aT^b$, where E is the electromotive force generated by the thermo-element, and a and b certain empirical constants, b varying from 3.5 to 4.2 with 17 instruments tested.

The E.M.F. indicated by several Féry total radiation pyrometers showed a marked lag effect due to a slow heating of the couple. Frequently, as long an exposure as ten minutes is required before the maximum reading is attained. In other cases the lag was less than twenty seconds. After the maximum reading was shown, the E.M.F. for several instruments dropped an equivalent of 10° C., during the first ten minutes when sighted as a furnace at 1300° C., while other instruments maintained a constant value. This drop is due to the conduction of heat from the hot to cold junction of the thermo-element, and can be easily minimized by increasing this distance. Preliminary measurements upon the total emissivity of various substances met with in industrial work have shown that the equation

$$\mathrm{E} = b(\log S - \log T)$$

is applicable where E is the total emissivity, b the exponent for the particular radiation pyrometer used, S the apparent temperature and T the true temperature absolute. Using this relation, E for iron oxide was found to be 0.86, for nickel oxide 0.83. A slight indication of a temperature coefficient of emissivity was found, E increasing with temperature, but the variation was almost within the limit of errors of observation.